United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with United States Department of the Interior, National Park Service

Soil Survey of Chaco Culture National Historical Park, New Mexico

How To Use This Soil Survey

General Soil Map

The general soil map, which is a color map, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

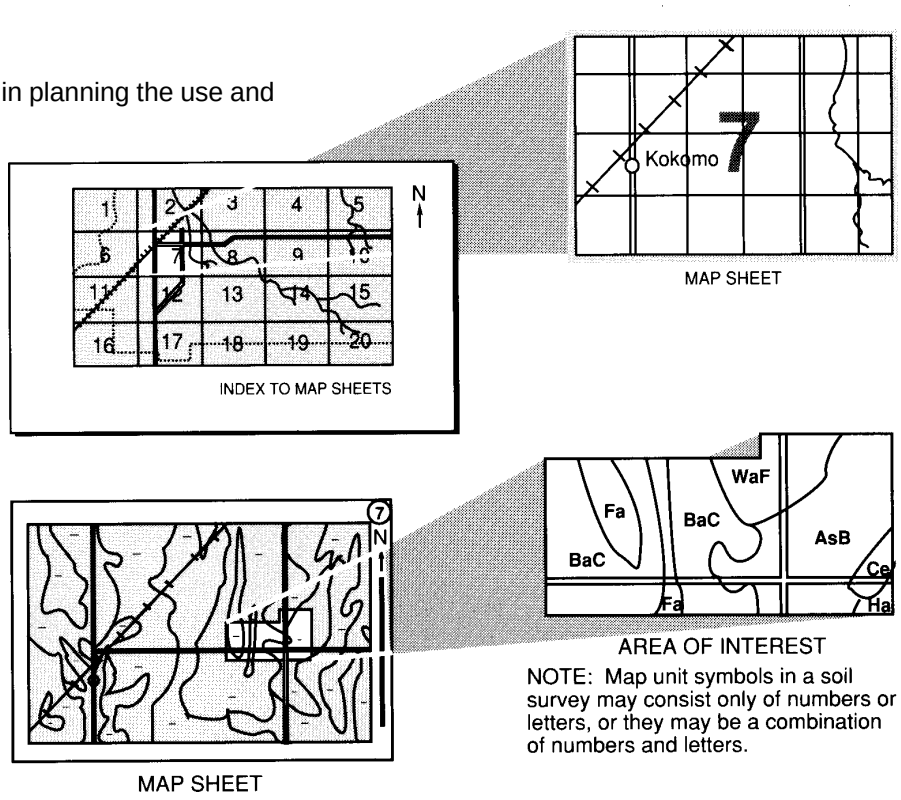
Detailed Soil Maps

The detailed soil maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**. Note the number of the map sheet and turn to that sheet.

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Contents**, which lists the map units by symbol and name and shows the page where each map unit is described.

The **Contents** shows which table has data on a specific land use for each detailed soil map unit. Also see the **Contents** for sections of this publication that may address your specific needs.



NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and the Department of the Interior, National Park Service. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Fieldwork for this soil survey was completed in 2001. Soil names and descriptions were approved in June 2002. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 2001. This survey was made cooperatively by the Natural Resources Conservation Service and the National Park Service.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

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Cover: View of Fajada Butte, the major landform in the area. Battlerock and Notal soils are in the foreground.

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Foreword

This report contains information that can be used in land-planning programs for Chaco Culture National Historical Park. It contains predictions of soil behavior for selected land uses. The report also highlights soil limitations, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. It can be used to evaluate the potential of the soil and the management needed for resource protection and enhancement. Conservationists, researchers, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. The information in this report is intended to identify soil properties that are used in making various land use or land treatment decisions. Statements made in this report are intended to help the National Park Service identify and reduce the effects of soil limitations on various land uses. The user is responsible for identifying and complying with existing laws and regulations.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited for use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information is available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Rosendo Trevino III
State Conservationist
Natural Resources Conservation Service

Soil Survey of Chaco Culture National Historical Park, New Mexico

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United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with the United States Department of the Interior, National Park Service

General Nature of the Area

Chaco Culture National Historic Park lies close to the center of the San Juan Basin in northwestern New Mexico near the southeastern edge of the Colorado Plateau physiographic province covering parts of San Juan and McKinley Counties. The Park is about 33,974 acres in size and consists of a large main unit and three smaller discontinuous units.

The average annual precipitation for the area is about 9 inches. Average annual temperature is about 49 degrees. The growing season is about 110 days in length. Elevations range from about 6,000 feet to 6,900 feet. The vegetation consists primarily of desert grasses and shrubs with some pinyon and juniper on north aspects at the higher elevations on Chaco Mesa.

The Park is west of the Continental Divide. Drainage trends to the west and northwest, and is collected by the intermittent Chaco River, Chaco Wash, Escavada Wash, and other small tributaries.

Previous Publications

The Soil Survey of San Juan County, New Mexico, Eastern Part, issued November, 1980, covers the large main unit of Chaco Culture National Historical Park and some of the small outliers. A few small outliers of Park Lands that were not covered in the San Juan report were mapped as part of the McKinley County Area soil survey, which is nearing completion.

Both soil surveys are designed to meet the needs for general land use planning, principally for livestock grazing and forest products. Therefore they are somewhat general in nature. All areas within McKinley County have been mapped at a scale of 1:24,000. The San Juan survey was mapped at a scale of 1:63,360 in and around the park. Although the area was mapped, few detailed soil examinations occurred. Most observations were on aerial photographs. Soil delineations were based principally upon photo interpretation and projection of similar known soil units into the area.

A Brief History of Chaco

Chaco Culture National Historical Park is in a long, shallow canyon that is centrally located within the San Juan Basin of northwestern New Mexico. The canyon was carved into the basin by what is now known as the Chaco Wash, a tributary of the San Juan River. The park lies primarily along this wash and its tributaries and includes archaeological sites both inside and outside of the canyon. These sites represent a

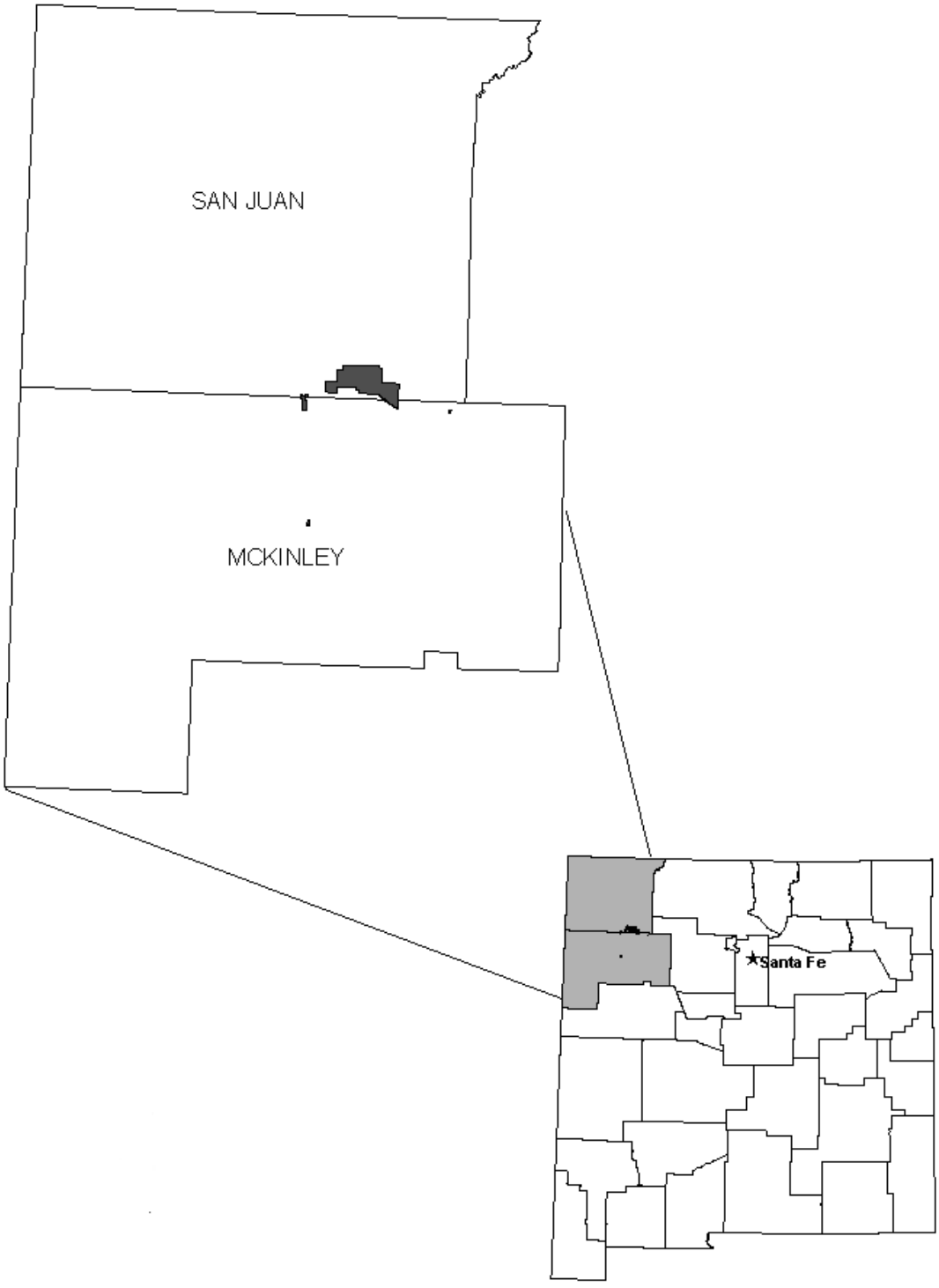

Figure 1.—Location of Chaco Culture National Historical Park in New Mexico. The park is not one continguous mass but has a few outliers.

prehistoric cultural system, which at one time extended throughout the basin. The San Juan Basin has been occupied for over 10,000 years and has been home to Paleo-Indians, Archaic people, the Anasazi, the Navajo, and people of Hispanic and Anglo descent.

The Anasazi ruins of Chaco are the tangible remains of a culture that flourished in the canyon from A.D. 900 through A.D. 1150. There are 13 major ruins in the canyon, and over 3,500 sites have been recorded within the park boundaries. Approximately half of the 3,500 sites are above ground, either as masonry structures or rock art in the cliff faces. The major ruins consist of multi-roomed and multi-storied structures, some of which cover several acres and contain as many as 800 rooms. The most famous of these is Pueblo Bonito. With its finely detailed masonry, elegantly battered walls and overall imposing massiveness, this finely engineered structure is all the more remarkable for having been built without the use of power tools, beasts of burden, or the wheel.

Today the ruins look much as they did within a few hundred years of abandonment. None of the structures in the park have been completely reconstructed, although it has been necessary to maintain and stabilize them since excavation. For example, when the great kiva of Casa Rinconada was excavated, it was in very poor condition, and a great deal of repair work was needed to restore its well-built appearance. Yet it still is not a complete structure. The other large sites in the central canyon have also been excavated, and extensive maintenance has been done on them. Other sites have been excavated and covered over again. All of the major ruins have been stabilized above ground, but care has been taken not to alter the appearance of the walls as they were found.

Trade

During its Classic period (1020-1120), Chaco was the center of a far-ranging trade network. Goods were exchanged internally within the Chacoan system and externally with groups as far south as Mexico. Chaco's distinctive Cibola black-on-white pottery may have originated in outlying towns to the south and west. According to one estimate, only about 20 percent of the pottery used at Chaco was made there.

Turquoise was a precious commodity in the Chacoan world. Great quantities of finished ornaments, offerings, and work-site debris were found throughout Chaco Canyon. Raw turquoise was imported from distant mines and transformed with exquisite craftsmanship into beads, necklaces, and pendants. Large amounts of this jewelry may have been traded to the regional center of Paquim (Casas Grandes) in northern Mexico. The well-known small frog found in Pueblo Bonito is carved from jet, its eyes and collar inlaid with turquoise.

Other evidence of a trade system found includes the many seashells (often strung into necklaces), copper bells, and remains of macaws and parrots. The two latter items suggest further contact with Mexico, perhaps with the ancient Toltecs.

The Canyon is Abandoned

The people of Chaco left the canyon around A.D. 1200, and for a few centuries Chaco remained undisturbed. The Navajo arrived in the area in the 1400's but did not settle in the canyon until the early 1700's. In the middle of the 19th century, several of the park's major ruins were rediscovered and thoroughly described by First Lt. James H. Simpson, who came through the canyon on a military expedition. The first archaeological investigation in Chaco commenced in May, 1896, when the Hyde Exploring Expedition started work on Pueblo Bonito. This expedition launched over a century of archaeological excavations and surveys in the canyon and outlying areas, and led to the creation of Chaco Canyon National Monument in 1907.

Since 1896, a considerable amount of information has been gathered about the ruins of Chaco and the people who built them. We know they designed turquoise jewelry, coiled pots, wove sandals, and carved flutes. We know that socially, they had the ability to organize and supervise laborers in order to build such complex structures. Much information has been acquired about the Anazazi through the archaeological record, yet just as much is not known about these gifted and determined prehistoric masons and their culture. We don't know what their music sounded like or how their food tasted, nor do we know how they recognized the change in seasons or celebrated the birth of a baby. When you visit Chaco, enjoy these mysteries and allow your imagination to recreate what we can no longer see, hear, touch, or smell. As you walk through these impressive structures of prehistory, be respectful and understand that there will always be questions about the canyon and its people that will remain unanswered.

Chaco Canyon National Monument was created by legislation on March 11, 1907, under the auspices of the 1906 Antiquities Act. In 1980, Public Law 96-550 was passed, expanding the monument boundaries and changing it to Chaco Culture National Historical Park. The park received international recognition when it was recognized as a World Heritage Cultural Park on December 8, 1987.

Climate

Prepared by the Natural Resources Conservation Service's National Weather and Climate Center, Portland, Oregon.

Climate tables are created from climate station Chaco Canyon National Historical Park, New Mexico. Thunderstorm days, relative humidity, percentage of sunshine, and wind information are estimated from First Order station, Albuquerque, New Mexico.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Chaco Canyon National Historical Park in the period 1971 to 2000. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on the length of the growing season.

In winter, the average temperature is 30.2 degrees F, and the average daily minimum temperature is 15.1 degrees. The lowest temperature on record, which occurred at Chaco Canyon on December 12, 1961, is -38 degrees F. In summer, the average temperature is 69.6 degrees F, and the average daily maximum temperature is 87.7 degrees. The highest recorded temperature, which occurred at Chaco Canyon on July 26, 1979, is 104 degrees F.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 9.45 inches. Of this, about 4.14 inches, or 44 percent, usually falls in June through September. The growing season for most crops falls within this period. The heaviest 1-day rainfall during the period of record was 2.90 inches at Chaco Canyon on December 15, 1961. Thunderstorms occur on about 41 days each year, most of them between May and September and more than 22 occurring in July and August.

The average seasonal snowfall is 14.0 inches. The greatest snow depth at any one time during the period of record was 11 inches, recorded on May 6, 1978. On average, 7 days of the year have at least 1 inch of snow on the ground. The heaviest 1-day snowfall on record was 12.0 inches, recorded on April 1, 1949.

The average relative humidity in midafternoon is about 40 percent in the winter and between 15 and 20 percent in the summer. Humidity is higher at night, and the average at dawn is about 70 percent in the winter and 45 percent in the summer. The sun shines about 75 to 80 percent of the time in summer and about 65 to 70 percent in winter. The prevailing wind is from the northwest in the winter and early spring, and from the south and southeast the remainder of the year. Average windspeed is highest, 12 miles per hour, in April.

Geology of Chaco Canyon

Stephen L. Lacy, geomorphologist, prepared this section.

Chaco Canyon is located within the Colorado Plateau physiographic province. It lies near the center of the structural feature known as the San Juan Basin. The basin is a northwest-trending asymmetric structural depression. Rocks dip steeply (up to 60 degrees) on the east, north and northwestern flanks of the basin, whereas on the west and southwestern edges the rock strata dip from 1 to 3 degrees. Broad outcropping areas of horizontally bedded, Late Cretaceous-aged sandstones and shales characterizes the region. These rock units were deposited approximately 75-80 million years ago when the region was part of a fluctuating inland sea coastline.

Within Chaco Canyon, the exposed bedrock is part of the Mesaverde Group. Two formations from this group, the Menefee Formation and the Cliff House Sandstone, are seen at the park. Two younger units, the Lewis Shale and the Picture Cliffs Sandstone, are exposed only along the park's northern boundary (Molenaar, 1977).

Menefee Formation

The oldest bedrock unit found at Chaco Canyon is the Menefee Formation. The Menefee is the non-marine middle unit of the Mesa Verde Group. It represents continental fluvial and nearshore deltaic and shoreline deposition during a major regression of the Upper Cretaceous Sea in northwestern New Mexico. It was deposited from sediments deposited by north- and east-flowing rivers that emptied into the retreating Interior Seaway.

At the edge of the seaway, the streams joined a flat coastal plain containing swamps, lagoons, and deltas. Plant materials accumulating in these areas formed thin coal beds. Other major components of the Menefee include siltstone and mudstone interbedded with sandstone and carbonaceous shale.

The Menefee Formation can be found at Chaco Canyon as a slope-forming unit underlying the steep mesa walls. It can be best viewed on the southern side of the canyon, and also on Fajada Butte. The widening of the canyon is a direct response to the Menefee Formation eroding from underneath the overlying Cliff House Sandstone. The undermined sandstone breaks

away in blocks and tumbles into the canyon. This has led to the creation of the striking cliff faces and the talus slopes containing sandstone blocks that rest at the base of the cliffs (Siemers, 1977).

Cliff House Sandstone

The Cliff House Sandstone was deposited during a transgressive (advancing) episode of the Inland Sea. It consists of a complex sequence of marine sandstone interbedded with shale seams. The Cliff House overlies the Menefee Formation and forms the prominent cliffs seen throughout the canyon. There are three principal units within the formation. The lower formation is massively bedded sandstone containing ripple marks and a wide variety of fossils. This unit forms the 80- to 100-foot cliffs occupying the lower portion of the sandstone walls.

Overlying the lower, massive sandstone is an intermediate sandstone and shale unit. This unit was deposited primarily as shallow water sand; however, the presence of the interbedded shale gives evidence of deeper water deposition at some point in the depositional history. Erosion is more prominent in this unit because of the presence of shale. This is expressed as a gently sloping face within the sandstone cliffs.

The uppermost unit is known as the Upper Sandstone. It is similar in composition to the lower cliff-forming sandstone. It was deposited as nearshore beach sand. The lack of shale shows that the sea was again retreating toward the west. The Upper Sandstone forms prominent cliffs and ledges.

Lewis Shale

The Lewis Shale is found in the extreme northeast portion of the park. It represents another significant transgressive episode of the Western Interior Seaway. The Lewis Shale consists of marine-deposited gray shale, siltstone, and mudstone, with some sandstone seams. Many thin bentonite beds are found within this formation. The Lewis Shale forms a narrow, rolling upland plain north of the park.

Picture Cliffs Sandstone

The Picture Cliffs Sandstone is regressive coastal-barrier sandstone that represents the final retreat of the Western Interior Seaway. This formation is massive bedded, cliff-forming, and resistant to erosion. For the most part, the Picture Cliffs Sandstone is located north of the park. It is expressed as sandstone ridges and outcrops seen north of the boundary fence.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas, their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept or model of how they were formed. During mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Individual soils on the landscape commonly merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. These observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each

taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years. However, they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

General Soil Map Units

The general soil map in this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage (fig. 2). Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The components of one map unit can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Soil descriptions

Soils on Flood Plains and Stream Terraces

The soils in this group make up about 13 percent of the survey area. These soils are very deep and level. They are sandy to clayey in texture and moderately well drained to well drained. They are subject to periods of flooding that range from rare to frequent. The native vegetation is black greasewood and alkali sacaton on the stream terraces, and cottonwood, willows, and sand dropseed on the flood plains of Chaco Wash and the Chaco River.

1—Battlerock-Notal-Beebe-Escawetter

Setting

Slope: 0 to 1 percent
Elevation: 6,000 to 6,300 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 48 to 50 degrees F.
Frost-free period: 100 to 135 days

Composition

Percent of survey area: 13
- Battlerock soils: 4 percent
- Notal soils: 4 percent
- Bebee soils: 3 percent
- Escawetter soils: 3 percent

Soils Properties and Qualities

Battlerock

Geomorphic position: stream terraces on valley floors
Depth class: very deep
Drainage class: well drained
Parent material: stream alluvium derived from sandstone and shale
Textural class: moderately fine textured
Hazard of flooding: rare

Notal

Geomorphic position: stream terraces on valley floors
Depth class: very deep
Drainage class: well drained
Parent material: stream alluvium derived from shale
Textural class: fine textured
Hazard of flooding: rare

Beebe and Escawetter

Geomorphic position: flood plains on valley floors
Depth class: very deep
Drainage class: well drained and moderately well drained
Parent material: stream alluvium derived from sandstone and shale
Textural class: moderately coarse to coarse textured
Hazard of flooding: frequent

Management Factors

Battlerock: piping and soil erosion
Notal: piping and soil erosion
Beebe and Escawetter: flooding and soil blowing

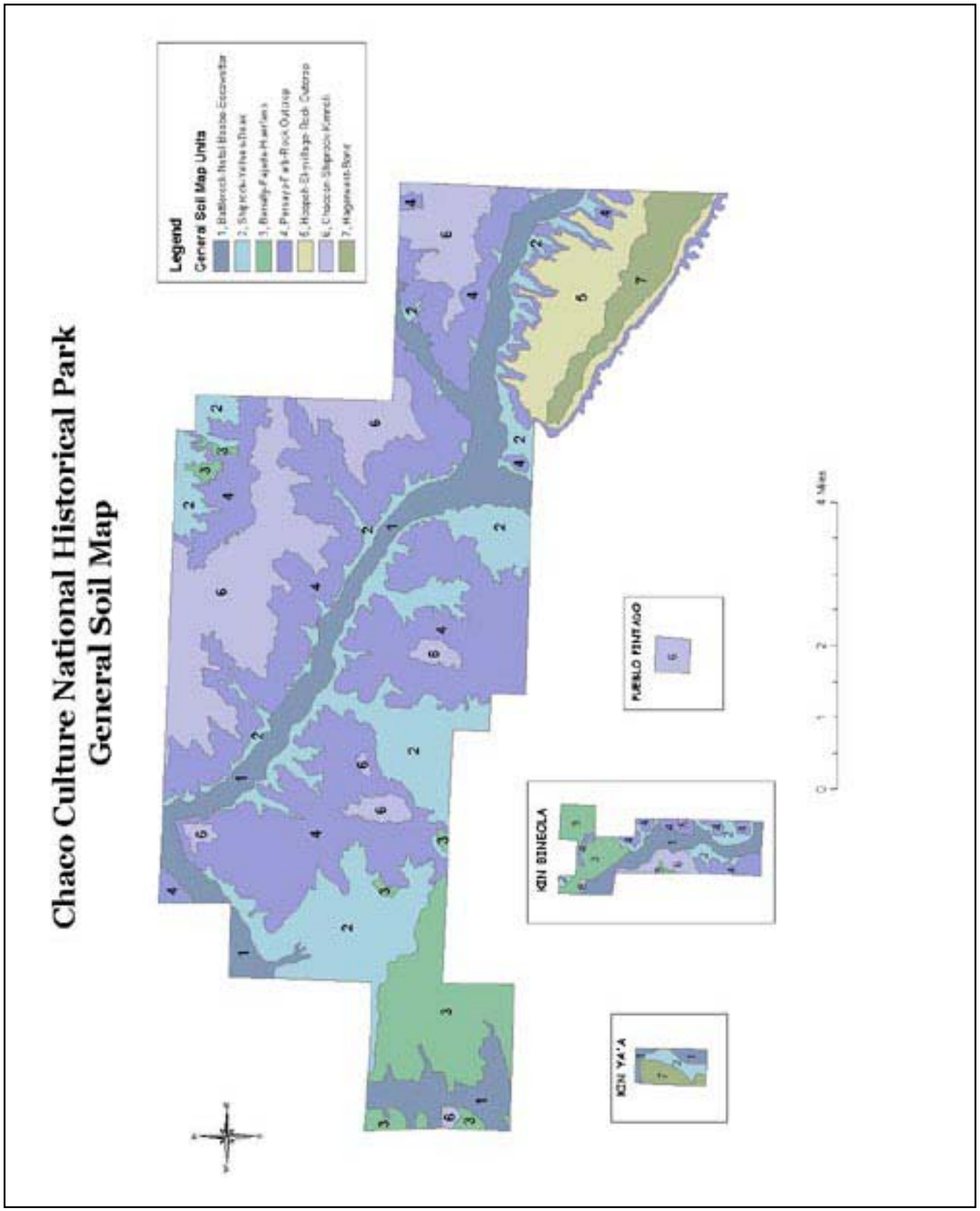

Figure 2.—This general soil map shows the patterns of map unit distribution in the survey area.

Soils on Alluvial Fans and Fan Remnants

The soils in this group make up about 19 percent of the survey area. These soils are very deep and gently to moderately sloping. They are moderately coarse to moderately fine textured and well drained. The native vegetation is fourwing saltbush, galleta, giant dropseed, and sand dropseed.

2—Shiprock-Yelives-Doak

Setting

Slope: 1 to 8 percent
Elevation: 6,000 to 6,300 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 48 to 50 degrees F.
Frost-free period: 100 to 135 days

Composition

Percent of survey area: 19
Shiprock soils: 9 percent
Yelives soils: 2 percent
Doak soils: 2 percent

Soils Properties and Qualities

Shiprock

Geomorphic position: fan remnants on valley sides
Depth class: very deep
Drainage class: well drained
Parent material: fan alluvium derived from sandstone and shale
Textural class: moderately coarse textured

Yelives

Geomorphic position: alluvial fans on valley sides
Depth class: very deep
Drainage class: well drained
Parent material: fan alluvium derived from sandstone
Textural class: moderately coarse textured
Hazard of flooding: frequent

Doak

Geomorphic position: fan remnants on valley sides
Depth class: very deep
Drainage class: well drained
Parent material: fan alluvium derived from shale and sandstone
Textural class: medium to moderately fine textured

Management Factors

Shiprock: soil blowing
Yelives: flooding
Doak: soil erosion

Soils on Erosional Terraces that are Sodium-Affected

The soils in this group make up about 8 percent of the survey area. These soils are very shallow to very deep and nearly level. They are medium to moderately fine textured and well drained. These soils have high sodium content. The native vegetation is mound saltbush and alkali sacaton. Badland and Rock outcrop are minor components.

3—Benally-Fajada-Huerfano

Setting

Slope: 1 to 5 percent
Elevation: 6,000 to 6,200 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 48 to 50 degrees F.
Frost-free period: 100 to 135 days

Composition

Percent of survey area: 8
Benally soils: 2 percent
Fajada soils: 3 percent
Huerfano soils: 2 percent

Soils Properties and Qualities

Benally

Geomorphic position: stream terraces and erosional terraces
Depth class: deep and very deep
Drainage class: well drained
Parent material: stream alluvium over residuum derived from sandstone and shale
Textural class: medium textured

Fajada

Geomorphic position: erosional terraces
Depth class: moderately deep
Drainage class: well drained
Parent material: alluvium over residuum derived from sandstone and shale
Textural class: medium textured

Huerfano

Geomorphic position: erosional terraces
Depth class: very shallow and shallow
Drainage class: well drained
Parent material: alluvium over residuum derived from sandstone and shale

Textural class: moderately fine textured

Management Factors

Benally: high sodium
Fajada: high sodium, depth to bedrock
Huerfano: high sodium, depth to bedrock

Soils of Escarpments

The soils in this group make up about 41 percent of the survey area. These soils are generally very shallow to shallow and nearly level to very steep on the structural benches. They are moderately coarse to fine textured and well drained.

4—Persayo-Farb-Rock Outcrop

Setting

Slope: 5 to 70 percent
Elevation: 6,000 to 6,600 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 48 to 50 degrees F.
Frost-free period: 100 to 135 days

Composition

Percent of survey area: 35
Persayo soils: 16 percent
Farb soils: 3 percent
Rock outcrop: 18 percent

Soils Properties and Qualities

The vegetation on this unit is characterized by fourwing saltbush, galleta, blue grama, alkali sacaton, bigelow sage, winterfat, mormon tea, and scattered oneseed juniper. This unit is drier and somewhat lower in elevation than unit 5.

Persayo

Geomorphic position: escarpments on mesas and cuestas
Depth class: very shallow and shallow
Drainage class: well drained
Parent material: slope alluvium over residuum derived from sandstone and shale
Textural class: moderately coarse textured

Farb

Geomorphic position: structural benches on escarpments of mesas and cuestas
Depth class: very shallow and shallow
Drainage class: well drained
Parent material: slope alluvium over residuum derived from sandstone
Textural class: moderately coarse textured

Management Factors

Persayo: steep slopes, depth to bedrock
Farb: steep slopes, depth to bedrock

5—Hospah-Skyvillage-Rock Outcrop

Setting

Slope: 2 to 80 percent
Elevation: 6,400 to 6,800 feet
Mean annual precipitation: 10 to 13 inches
Mean annual air temperature: 48 to 50 degrees F.
Frost-free period: 100 to 135 days

Composition

Percent of survey area: 6
Hospah soils: 1 percent
Skyvillage soils: 1 percent
Rock outcrop: 1 percent

Soils Properties and Qualities

The vegetation on this unit is characterized by fourwing saltbush, rubber rabbitbrush, bitterbrush, mountain mahogany, galleta, blue grama, bigelow sage, and scattered twoneedle pinyon and oneseed juniper. This unit is generally on north aspects, and is moister and somewhat higher in elevation than unit 4.

Hospah

Geomorphic position: escarpments on mesas and cuestas
Depth class: very shallow and shallow
Drainage class: well drained
Parent material: colluvium over residuum derived from shale and sandstone
Textural class: fine textured

Skyvillage

Geomorphic position: structural benches on escarpments of mesas and cuestas
Depth class: very shallow and shallow
Drainage class: well drained
Parent material: eolian material and slope alluvium derived from sandstone
Textural class: moderately coarse textured

Management Factors

Hospah: steep slopes, depth to bedrock
Skyvillage: steep slopes, depth to bedrock

Soils in Areas of Mesa Summits and Cuesta Dipslopes

The soils in this group make up about 19 percent of the survey area. These soils are very shallow to very deep and nearly level. They are moderately coarse and medium textured and well drained.

6—Chacoan-Shiprock-Kimnoli

Setting

Slope: 1 to 8 percent
Elevation: 6,000 to 6,700 feet
Mean annual precipitation: 8 to 10 inches
Mean annual air temperature: 48 to 50 degrees F.
Frost-free period: 100 to 135 days

Composition

Percent of survey area: 16
- Chacoan soils: 8 percent
- Shiprock soils: 6 percent
- Kimnoli soils: 1 percent

Soils Properties and Qualities

The vegetation on this unit is characterized by fourwing saltbush, rubber rabbitbrush, galleta, blue grama, and bigelow sage. This unit is drier and somewhat lower in elevation than unit 7.

Chacoan

Geomorphic position: dipslopes on cuestas and summits of mesas
Depth class: moderately deep
Drainage class: somewhat excessively drained
Parent material: eolian material and slope alluvium derived from sandstone
Textural class: moderately coarse textured

Shiprock

Geomorphic position: dipslopes on cuestas and summits of mesas
Depth class: very deep
Drainage class: somewhat excessively drained
Parent material: eolian material and slope alluvium derived from sandstone
Textural class: moderately coarse textured

Kimnoli

Geomorphic position: summits on mesas
Depth class: very shallow and shallow
Drainage class: well drained
Parent material: eolian material and slope alluvium derived from sandstone
Textural class: moderately coarse textured

Management Factors

Chacoan: soil blowing, depth to bedrock
Shiprock: soil blowing
Kimnoli: soil blowing, depth to bedrock

7—Hagerwest-Bond

Setting

Slope: 1 to 8 percent
Elevation: 6,700 to 6,900 feet
Mean annual precipitation: 10 to 13 inches
Mean annual air temperature: 48 to 50 degrees F.
Frost-free period: 100 to 135 days

Composition

Percent of survey area: 3
- Hagerwest soils: 2 percent
- Bond soils: 1 percent

Soils Properties and Qualities

The vegetation on this unit is characterized by fourwing saltbush, rubber rabbitbrush, Indian ricegrass, galleta, blue grama, winterfat, and scattered juniper. This unit is moister and somewhat higher in elevation than unit 6.

Hagerwest

Geomorphic position summits of mesas
Depth class: moderately deep
Drainage class: well drained
Parent material: eolian material and slope alluvium derived from sandstone and shale
Textural class: medium textured

Bond

Geomorphic position: summits of mesas
Depth class: very shallow to shallow
Drainage class: well drained
Parent material: eolian material and slope alluvium derived from sandstone
Textural class: moderately coarse and medium textured

Management Factors

Hagerwest: depth to bedrock
Bond: depth to bedrock

Detailed Soil Map Units

The map units delineated on the detailed soil maps in this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The contrasting components are mentioned in the map unit descriptions. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, an onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a soil series. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into soil phases. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Notal silty clay loam is a phase of the Notal series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A complex consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Chacoan-Shiprock loamy fine sands, 1 to 8 percent slopes, is an example.

An association is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or

necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Benally-Fruitland association, 1 to 5 percent slopes, is an example.

This survey includes miscellaneous areas. Such areas have little or no soil material and support little or no vegetation. Riverwash is an example.

Table 4 gives acreage and proportionate extent of each map unit. Other tables give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

Soil descriptions

2—Battlerock-Notal complex, 0 to 1 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,000 to 6,300 feet (1,829 to 1,920 meters)
Mean annual precipitation: 8 to 10 inches (203 to 254 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)
Frost-free period: 100 to 135 days

Map Unit Composition

Battlerock and similar soils: 45 percent
Notal and similar soils: 35 percent
Minor components: 20 percent

Component Descriptions

Battlerock soils

Geomorphic position: Stream terraces
Parent material: Stream alluvium derived from sandstone and shale
Slope: 0 to 1 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Well drained
Slowest permeability: about 0.06 in/hr (slow)
Available water capacity: Moderate (about 6.9 inches)
Shrink-swell potential: Moderate (about 6.0 LEP)
Flooding hazard: Rare
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Medium
Calcium carbonate maximum: about 5 percent
Gypsum maximum: about 5 percent
Salinity maximum: about 4 mmhos/cm (very slightly saline)
Sodicity maximum: about 5 SAR (slightly sodic)
Ecological site: Clay Loam Terrace (sodic) 5-8" p.z.
Present native vegetation: mound saltbush, galleta, black greasewood, alkali sacaton (fig. 3)
Land capability (nonirrigated): 7c

Figure 3.—Typical landscape of Battlerock-Notal complex, 0 to 1 percent slopes. Black greasewood and alkalai sacaton dominate this site.

Figure 4.—Soil piping on the Battlerock and Notal soils. Piping is a mangement concern in the Park and threatens roads and ruins.

Typical Profile:
A—0 to 3 inches; fine sandy loam
Bw—3 to 7 inches; clay loam
C1—7 to 11 inches; stratified clay loam
C2—11 to 17 inches; stratified loam
Cy1—17 to 23 inches; stratified clay loam
Cy2—23 to 35 inches; sandy clay loam
Cy3—35 to 42 inches; silty clay loam
Cy4—42 to 65 inches; silty clay

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Notal soils

Geomorphic position: Stream terraces
Parent material: Stream alluvium derived from sandstone and shale
Slope: 0 to 1 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Well drained
Slowest permeability: about 0.03 in/hr (very slow)
Available water capacity: Moderate (about 6.7 inches)
Shrink-swell potential: High (about 7.1 LEP)
Flooding hazard: Rare
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: High
Calcium carbonate maximum: about 5 percent
Gypsum maximum: about 5 percent
Salinity maximum: about 8 mmhos/cm (slightly saline)
Sodicity maximum: about 10 SAR (slightly sodic)
Ecological site: Clay Loam Terrace (sodic) 5-8" p.z.
Present native vegetation: mound saltbush, galleta, greasewood, alkali sacaton (fig. 4)
Land capability (nonirrigated): 7c

Typical Profile:
A—0 to 2 inches; clay loam
Bw—2 to 7 inches; clay loam
Bk—7 to 14 inches; clay

Bky—14 to 19 inches; clay
BC1—19 to 26 inches; silty clay loam
BC2—26 to 70 inches; silty clay

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Minor Components

Doak and similar soils
Estimated composition: about 10 percent
Slope: 0 to 2 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Well drained
Ecological site: Loamy Upland 5-8" p.z.

Yelives and similar soils
Estimated composition: about 10 percent
Slope: 0 to 2 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Well drained
Ecological site: Loamy Upland 5-8" p.z.

3—Beebe silt loam, 0 to 1 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,100 to 6,300 feet (1,859 to 1,920 meters)
Mean annual precipitation: 8 to 10 inches (203 to 254 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)
Frost-free period: 100 to 135 days

Map Unit Composition

Beebe and similar soils: 90 percent
Minor components: 10 percent

Component Descriptions

Beebe soils

Geomorphic position: Flood plains
Parent material: Stream alluvium derived from sandstone and shale
Slope: 0 to 1 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Well drained
Slowest permeability: about 0.60 in/hr (moderate)
Available water capacity: Low (about 4.0 inches)
Shrink-swell potential: Low (about 1.5 LEP)
Flooding hazard: Frequent
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Negligible
Calcium carbonate maximum: about 5 percent
Gypsum maximum: about 1 percent
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 2 SAR (slightly sodic)
Ecological site: Sandy Bottom 5-8" p.z.
Present native vegetation: Indian ricegrass, saltcedar, alkali sacaton, fourwing saltbush, sand dropseed, galleta, broom snakeweed, giant dropseed, inland saltgrass, rabbitbrush, and few scattered cottonwoods.
Land capability (nonirrigated): 7w

Note: There is one significant area along the upper stretch of Chaco Wash where water ponds in the channel for extended periods of time. This area provides a valuable water source for Park wildlife.

Typical Profile:
AC—0 to 5 inches; silt loam
C1—5 to 12 inches; stratified fine sandy loam
C2—12 to 15 inches; stratified loam
C3—15 to 20 inches; fine sand
C4—20 to 30 inches; stratified fine sand
C5—30 to 70 inches; fine sand

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Minor Components

Yelives and similar soils
Estimated composition: about 10 percent
Slope: 0 to 1 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Somewhat excessively drained
Ecological site: Sandy Bottom 5-8" p.z.

4—Yelives-Beebe fine sandy loams, 1 to 5 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,100 to 6,300 feet (1,859 to 1,920 meters)
Mean annual precipitation: 8 to 10 inches (203 to 254 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)
Frost-free period: 100 to 135 days

Map Unit Composition

Yelives and similar soils: 45 percent
Beebe and similar soils: 40 percent
Minor components: 15 percent

Component Descriptions

Beebe soils

Geomorphic position: Alluvial fans
Parent material: Fan alluvium derived from sandstone and shale
Slope: 1 to 5 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Well drained
Slowest permeability: about 0.60 in/hr (moderate)
Available water capacity: Low (about 4.7 inches)
Shrink-swell potential: Low (about 1.5 LEP)
Flooding hazard: Frequent
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Very low
Calcium carbonate maximum: about 5 percent
Gypsum maximum: about 1 percent
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 2 SAR (slightly sodic)
Ecological site: Loamy Upland 5-8" p.z.
Present native vegetation: blue grama, western wheatgrass, Indian ricegrass, fourwing saltbush, sand dropseed, spike dropseed, galleta, rabbitbrush, sand sagebrush
Land capability (nonirrigated): 7c

Typical Profile:
A—0 to 3 inches; fine sandy loam
C1—3 to 7 inches; fine sandy loam
C2—7 to 16 inches; fine sandy loam
C3—16 to 25 inches; fine sandy loam
C4—25 to 34 inches; stratified loamy fine sand
C5—34 to 52 inches; stratified sand
C6—52 to 56 inches; silt loam
C7—56 to 70 inches; fine sandy loam

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Yelives soils

Geomorphic position: Alluvial fans
Parent material: Fan alluvium derived from sandstone
Slope: 1 to 5 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Somewhat excessively drained
Slowest permeability: about 0.60 in/hr (moderate)
Available water capacity: Low (about 5.1 inches)
Shrink-swell potential: Low (about 1.5 LEP)
Flooding hazard: Frequent
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Very low
Calcium carbonate maximum: about 5 percent
Gypsum maximum: about 1 percent
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 5 SAR (slightly sodic)
Ecological site: Loamy Upland 5-8" p.z.
Present native vegetation: blue grama, Indian ricegrass, fourwing saltbush, sand dropseed, galleta, rabbitbrush, sand sagebrush
Land capability (nonirrigated): 7c

Typical Profile:
A—0 to 3 inches; fine sandy loam
C1—3 to 8 inches; stratified loam
C2—8 to 28 inches; stratified fine sandy loam
Ck1—28 to 42 inches; loamy fine sand
Ck2—42 to 55 inches; fine sandy loam
Ck3—55 to 70 inches; loamy fine sand

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Minor Components

Battlerock and similar soils
Estimated composition: about 10 percent
Slope: 1 to 5 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Well drained
Ecological site: Clay Loam Terrace (sodic) 5-8" p.z.

Shiprock and similar soils
Estimated composition: about 5 percent
Slope: 1 to 5 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Somewhat excessively drained
Ecological site: Sandy Loam Upland 5-8" p.z.

5—Farb-Rock outcrop complex, 5 to 20 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,000 to 6,600 feet (1,829 to 2,012 meters)

Mean annual precipitation: 8 to 10 inches (203 to 254 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)
Frost-free period: 100 to 135 days

Map Unit Composition

Rock outcrop: 45 percent
Farb and similar soils: 45 percent
Minor components: 10 percent

Component Descriptions

Farb soils

Geomorphic position: Structural benches on escarpments (fig. 5)
Parent material: Slope alluvium over residuum derived from sandstone
Slope: 5 to 20 percent
Surface fragments: about 3 percent
Depth to restrictive feature: 5 to 20 inches to bedrock (lithic)
Drainage class: Excessively drained
Slowest permeability: about 2.00 in/hr (moderately rapid)
Available water capacity: Very low (about 1.5 inches)
Shrink-swell potential: Low (about 1.5 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: High
Calcium carbonate maximum: about 5 percent
Gypsum maximum: None
Salinity maximum: about 0 mmhos/cm (nonsaline)
Sodicity maximum: about 0 SAR (nonsodic)
Ecological site: Sandstone Upland 5-8" p.z.
Present native vegetation: Indian ricegrass, Bigelow sagebrush, galleta, Mormon tea, New Mexico Feathergrass, black grama, blue grama, fourwing saltbush, sand dropseed, shadscale saltbush, sideoats grama, narrowleaf yucca
Land capability (nonirrigated): 7s

Typical Profile:
A—0 to 1 inches; loamy fine sand

Figure 5.—Typical landscape of Farb-Rock outcrop complex, 5 to 20 percent slopes.

Bw—1 to 5 inches; loamy fine sand
C1—5 to 11 inches; loamy fine sand
C2—11 to 15 inches; fine sandy loam
R—15 inches; hard sandstone bedrock

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Rock outcrop

Rock outcrop consists of barren or nearly barren areas of exposed sandstone and shale on ridges, ledges, and escarpments.

Minor Components

Chacoan and similar soils
Estimated composition: about 5 percent
Slope: 1 to 5 percent
Depth to restrictive feature: 20 to 40 inches to bedrock (lithic)
Drainage class: Somewhat excessively drained
Ecological site: Sandy Loam Upland 5-8" p.z.

Farb and similar soils
Estimated composition: about 5 percent
Slope: 20 to 40 percent
Depth to restrictive feature: 10 to 20 inches to bedrock (lithic)
Drainage class: Excessively drained
Ecological site: Sandstone Upland 5-8" p.z.

6—Chacoan-Shiprock loamy fine sands, 1 to 8 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,000 to 6,600 feet (1,829 to 2,012 meters)
Mean annual precipitation: 8 to 10 inches (203 to 254 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)
Frost-free period: 100 to 135 days

Map Unit Composition

Chacoan and similar soils: 50 percent
Shiprock and similar soils: 40 percent
Minor components: 10 percent

Component Descriptions

Chacoan soils

Geomorphic position: Dipslopes on cuestas
Parent material: Eolian material and slope alluvium derived from sandstone
Slope: 1 to 8 percent
Depth to restrictive feature: 20 to 40 inches to bedrock (lithic)
Drainage class: Somewhat excessively drained
Slowest permeability: about 2.00 in/hr (moderately rapid)
Available water capacity: Low (about 3.3 inches)
Shrink-swell potential: Low (about 1.0 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Low
Calcium carbonate maximum: about 5 percent
Gypsum maximum: None
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 0 SAR (nonsodic)
Ecological site: Sandy Loam Upland 5-8" p.z.
Present native vegetation: Indian ricegrass, blue grama, galleta, fourwing saltbush, winterfat, bottlebrush squirreltail, sand dropseed, broom snakeweed, rabbitbrush, sandhill muhly (fig. 6)

Note: The Pueblo Pintado outlier area has big sagebrush as a species component.

Land capability (nonirrigated): 7c

Typical Profile:
A—0 to 2 inches; loamy fine sand
Bt1—2 to 7 inches; fine sandy loam
Bt2—7 to 12 inches; fine sandy loam
Bt3—12 to 19 inches; fine sandy loam
Bk—19 to 24 inches; fine sandy loam
Cr—24 to 32 inches; weathered shale
R—32 inches; hard sandstone bedrock

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Shiprock soils

Geomorphic position: Dipslopes on cuestas
Parent material: Eolian material and slope alluvium derived from sandstone
Slope: 1 to 8 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Somewhat excessively drained
Slowest permeability: about 2.00 in/hr (moderately rapid)
Available water capacity: Low (about 5.4 inches)
Shrink-swell potential: Low (about 1.5 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet

Figure 6.—Open areas of Chacoan-Shiprock loamy fine sands, 1 to 8 percent slopes, in the northern parts of the Park.

Runoff class: Low
Calcium carbonate maximum: about 15 percent
Gypsum maximum: None
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 2 SAR (slightly sodic)
Ecological site: Sandy Loam Upland 5-8" p.z.
Present native vegetation: Indian ricegrass, blue grama, galleta, fourwing saltbush, winterfat, bottlebrush squirreltail, sand dropseed, broom snakeweed, rabbitbrush, sandhill muhly
Land capability (nonirrigated): 7c

Typical Profile:
A—0 to 2 inches; loamy fine sand
Bt1—2 to 4 inches; fine sandy loam
Bt2—4 to 21 inches; fine sandy loam
Btk—21 to 27 inches; fine sandy loam
Bk—27 to 52 inches; fine sandy loam
Ck—52 to 62 inches; fine sandy loam
Cr—62 inches; shale

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Minor Components

Doak and similar soils
Estimated composition: about 10 percent
Slope: 1 to 8 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Well drained
Ecological site: Loamy Upland 5-8" p.z.

7—Chacoan-Kimnoli loamy fine sands, 1 to 3 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,100 to 6,700 feet (1,859 to 2,042 meters)
Mean annual precipitation: 8 to 10 inches (203 to 254 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)
Frost-free period: 100 to 135 days

Map Unit Composition

Chacoan and similar soils: 45 percent
Kimnoli and similar soils: 35 percent
Minor components: 20 percent

Component Descriptions

Chacoan soils

Geomorphic position: Summits on mesas
Parent material: Eolian material and slope alluvium derived from sandstone
Slope: 1 to 3 percent
Depth to restrictive feature: 20 to 40 inches to bedrock (lithic)
Drainage class: Somewhat excessively drained
Slowest permeability: about 2.00 in/hr (moderately rapid)
Available water capacity: Low (about 3.1 inches)

Shrink-swell potential: Low (about 1.5 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Very low
Calcium carbonate maximum: about 5 percent
Gypsum maximum: None
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 0 SAR (nonsodic)
Ecological site: Sandy Loam Upland 5-8" p.z.
Present native vegetation: Indian ricegrass, blue grama, galleta, fourwing saltbush, winterfat, sand dropseed, broom snakeweed, rabbitbrush
Land capability (nonirrigated): 7c

Typical Profile:
A—0 to 3 inches; loamy fine sand
Bw—3 to 6 inches; loamy fine sand
Bt—6 to 18 inches; fine sandy loam
Bk—18 to 24 inches; fine sandy loam
R—24 inches; hard sandstone bedrock

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Kimnoli soils

Geomorphic position: Summits on mesas
Parent material: Eolian material and slope alluvium derived from sandstone
Slope: 1 to 3 percent
Surface fragments: about 3 percent
Depth to restrictive feature: 10 to 20 inches to bedrock (lithic)
Drainage class: Well drained
Slowest permeability: about 2.00 in/hr (moderately rapid)
Available water capacity: Very low (about 1.3 inches)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: High
Calcium carbonate maximum: about 5 percent
Gypsum maximum: None
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 0 SAR (nonsodic)
Ecological site: Sandstone Upland 5-8" p.z.
Present native vegetation: Indian ricegrass, Bigelow sagebrush, galleta, blue grama, fourwing saltbush, Mormon tea, sand dropseed, shadscale saltbush, sideoats grama, narrowleaf yucca
Land capability (nonirrigated): 7s

Typical Profile:
A—0 to 3 inches; loamy fine sand
Bt—3 to 10 inches; fine sandy loam
R—10 inches; hard sandstone bedrock

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Minor Components

Shiprock and similar soils
Estimated composition: about 10 percent
Slope: 1 to 3 percent
Depth to restrictive feature: 60 to 80 inches to bedrock (lithic and paralithic)
Drainage class: Somewhat excessively drained
Ecological site: Sandy Loam Upland 5-8" p.z.

Farb and similar soils
Estimated composition: about 10 percent
Slope: 1 to 3 percent
Depth to restrictive feature: 10 to 20 inches to bedrock (lithic)
Drainage class: Somewhat excessively drained
Ecological site: Sandstone Upland 5-8" p.z.

8—Notal silty clay loam, 0 to 1 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,000 to 6,200 feet (1,829 to 1,890 meters)
Mean annual precipitation: 8 to 10 inches (203 to 254 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)
Frost-free period: 100 to 135 days

Map Unit Composition

Notal and similar soils: 80 percent
Minor components: 20 percent

Component Descriptions

Notal soils

Geomorphic position: Stream terraces
Parent material: Stream alluvium derived from shale
Slope: 0 to 1 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Well drained

Slowest permeability: about 0.03 in/hr (very slow)
Available water capacity: Moderate (about 6.4 inches)
Shrink-swell potential: Moderate (about 5.4 LEP)
Flooding hazard: Rare
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Medium
Calcium carbonate maximum: about 5 percent
Gypsum maximum: about 5 percent
Salinity maximum: about 8 mmhos/cm (slightly saline)
Sodicity maximum: about 30 SAR (strongly sodic)
Ecological site: Clay Loam Terrace (sodic) 5-8" p.z.
Present native vegetation: mound saltbush, galleta, greasewood, alkali sacaton
Land capability (nonirrigated): 7c

Typical Profile:
A—0 to 3 inches; silty clay loam
Bw1—3 to 7 inches; silty clay
Bw2—7 to 14 inches; silty clay
Bky1—14 to 24 inches; silty clay
Bky2—24 to 58 inches; silty clay
C—58 to 65 inches; clay loam

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Minor Components

Battlerock and similar soils
Estimated composition: about 20 percent
Slope: 0 to 1 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Well drained
Ecological site: Clay Loam Terrace (sodic) 5-8" p.z.

9—Doak loam, 1 to 5 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,100 to 6,300 feet (1,859 to 1,920 meters)
Mean annual precipitation: 8 to 10 inches (203 to 254 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)
Frost-free period: 100 to 135 days

Map Unit Composition

Doak and similar soils: 85 percent
Minor components: 15 percent

Component Descriptions

Doak soils

Geomorphic position: Fan remnants
Parent material: Fan alluvium derived from sandstone and shale
Slope: 1 to 5 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Well drained
Slowest permeability: about 0.20 in/hr (moderately slow)
Available water capacity: Moderate (about 7.8 inches)
Shrink-swell potential: Moderate (about 4.5 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Medium
Calcium carbonate maximum: about 5 percent
Gypsum maximum: about 1 percent
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 2 SAR (slightly sodic)
Ecological site: Loamy Upland 5-8" p.z.
Present native vegetation: galleta, Indian ricegrass, fourwing saltbush, alkali sacaton, globe mallow, blue grama, winterfat
Land capability (nonirrigated): 7c

Typical Profile:
A—0 to 2 inches; loam
Bt1—2 to 8 inches; clay loam
Bt2—8 to 24 inches; clay loam
Bt3—24 to 31 inches; clay loam
Bk1—31 to 44 inches; clay loam
Bk2—44 to 54 inches; clay loam
BCk1—54 to 60 inches; clay loam
BCk2—60 to 70 inches; clay loam

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Minor Components

Battlerock and similar soils
Estimated composition: about 10 percent
Slope: 1 to 5 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Well drained
Ecological site: Clay Loam Terrace (sodic) 5-8" p.z.

Shiprock and similar soils
Estimated composition: about 5 percent
Slope: 1 to 5 percent

Figure 7.—Typical landscape of Yelives fine sandy loam, 0 to 1 percent slopes. Cottonwoods, and to a lesser extent willows, thrive in some areas of this soil, providing riparian habitat for Park wildlife.

Depth to restrictive feature: None within 60 inches
Drainage class: Somewhat excessively drained
Ecological site: Sandy Loam Upland 5-8" p.z.

10—Yelives fine sandy loam, 0 to 1 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,000 to 6,200 feet (1,829 to 1,890 meters)
Mean annual precipitation: 8 to 10 inches (203 to 254 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)
Frost-free period: 100 to 135 days

Map Unit Composition

Yelives and similar soils: 90 percent
Minor components: 10 percent

Component Descriptions

Yelives soils

Geomorphic position: Flood plains
Parent material: Stream alluvium derived from sandstone and shale
Slope: 0 to 1 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Well drained
Slowest permeability: about 0.60 in/hr (moderate)
Available water capacity: Low (about 5.5 inches)
Shrink-swell potential: Low (about 1.5 LEP)
Flooding hazard: Frequent
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Very low
Calcium carbonate maximum: about 5 percent
Gypsum maximum: about 1 percent
Salinity maximum: about 2 mmhos/cm (nonsaline)

Sodicity maximum: about 2 SAR (slightly sodic)
Ecological site: Sandy Bottom 5-8" p.z.
Present native vegetation: Indian ricegrass, saltcedar, alkali sacaton, fourwing saltbush, sand dropseed, galleta, broom snakeweed, giant dropseed, rabbitbrush, big sagebrush, cottonwoods, and willows (fig. 7)
Land capability (nonirrigated): 7w

Note: Ponded water exists in the channel near the confluence of Chaco Wash and the Chaco River. The source of the water is runoff from storm events and a possible perched water table. This area provides a valuable source of water for wildlife.

Typical Profile:
AC—0 to 4 inches; stratified fine sandy loam
C1—4 to 10 inches; fine sandy loam
C2—10 to 20 inches; stratified very fine sandy loam
C3—20 to 34 inches; stratified loam
C4—34 to 46 inches; fine sand
C5—46 to 52 inches; gravelly coarse sand
C6—52 to 70 inches; sand

Detailed descriptions of specific horizons are available in the "Soil Properties" section and under the heading "Classification of the Soils."

Minor Components

Beebe and similar soils
Estimated composition: about 10 percent
Slope: 0 to 1 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Somewhat excessively drained
Ecological site: Sandy Bottom 5-8" p.z.

12—Riverwash

Map Unit Composition

Riverwash: 100 percent

Component Descriptions

Riverwash

Riverwash consists of unstable sand and silt that is reworked by water and wind so frequently that it

Figure 8.— Riverwash is in the foreground. Escawetter fine sand, 0 to 1 percent slopes, are in the background. This landscape is frequently flooded.

supports little or no vegetation. There are very few areas of riverwash that have gravelly or cobbly layers within the Park boundaries. Riverwash occurs in stream channels. It is subject to frequent, brief periods of flooding from high intensity storms, July to November (fig. 8)
Geomorphic position: Channels
Parent material: Stream alluvium derived from sandstone
Slope: 0 to 1 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Moderately well drained
Slowest permeability: about 6.00 in/hr (rapid)
Available water capacity: Very low (about 0.4 inches)
Shrink-swell potential: Low (about 1.0 LEP)
Flooding hazard: Frequent
Ponding hazard: None
Seasonal water table minimum depth: about 47 inches
Runoff class: Negligible
Calcium carbonate maximum: about 1 percent
Gypsum maximum: about 1 percent
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 1 SAR (slightly sodic)
Land capability (nonirrigated): 8

13—Escawetter fine sand, 0 to 1 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,000 to 6,100 feet (1,829 to 1,859 meters)
Mean annual precipitation: 8 to 10 inches (203 to 254 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)
Frost-free period: 100 to 135 days

Map Unit Composition

Escawetter and similar soils: 95 percent
Minor components: 5 percent

Component Descriptions

Escawetter soils

Geomorphic position: Flood plains
Parent material: Stream alluvium derived from sandstone and shale
Slope: 0 to 1 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Moderately well drained
Slowest permeability: about 2.00 in/hr (moderate rapid)
Available water capacity: Very low (about 2.5 inches)
Shrink-swell potential: Low (about 1.5 LEP)
Flooding hazard: Frequent
Ponding hazard: None
Seasonal water table minimum depth: about 47 inches
Runoff class: Negligible
Calcium carbonate maximum: about 2 percent
Gypsum maximum: about 1 percent
Salinity maximum: about 4 mmhos/cm (very slightly saline)
Sodicity maximum: about 2 SAR (slightly sodic)
Ecological site: Sandy Bottom (subirrigated) 5-8" p.z.
Present native vegetation: alkali sacaton, Indian ricegrass, saltcedar, sand dropseed, Russian-olive, bottlebrush squirreltail
Land capability (nonirrigated): 7w

Typical Profile:
AC—0 to 6 inches; stratified fine sand
C1—6 to 19 inches; coarse sand
C2—19 to 38 inches; coarse sand
C3—38 to 65 inches; coarse sand

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Minor Components

Beebe and similar soils
Estimated composition: about 5 percent
Slope: 0 to 1 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Well drained
Ecological site: Sandy Bottom 5-8" p.z.

16—Rock outcrop-Persayo complex, 20 to 70 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,200 to 6,600 feet (1,890 to 2,012 meters)
Mean annual precipitation: 8 to 10 inches (203 to 254 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)
Frost-free period: 100 to 135 days

Map Unit Composition

Persayo and similar soils: 40 percent
Rock outcrop: 40 percent
Minor components: 20 percent

Component Descriptions

Rock outcrop

Rock outcrop consists of barren or nearly barren

areas of exposed sandstone and shale on ridges, ledges, and escarpments.

Persayo soils

Geomorphic position: Escarpments on mesas and cuestas
Parent material: Slope alluvium over residuum derived from sandstone and shale
Slope: 20 to 45 percent
Surface fragments: about 15 percent
Depth to restrictive feature: 5 to 20 inches to bedrock (paralithic)
Drainage class: Well drained
Slowest permeability: about 2.00 in/hr (moderately rapid)
Available water capacity: Very low (about 1.3 inches)
Shrink-swell potential: Low (about -0.0 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Very high
Calcium carbonate maximum: about 5 percent
Gypsum maximum: about 1 percent
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 2 SAR (slightly sodic)
Ecological site: Sandstone Upland 5-8" p.z.
Present native vegetation: Indian ricegrass, Bigelow sagebrush, galleta, blue grama, fourwing saltbush, Mormon tea, shadscale saltbush, wolfberry, prickly pear
Land capability (nonirrigated): 7e

Typical Profile:
A—0 to 2 inches; gravelly fine sandy loam
C—2 to 9 inches; fine sandy loam
Cr—9 to 23 inches; shale
R—23 inches; hard sandstone bedrock

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Minor Components

Farb and similar soils
Estimated composition: about 15 percent
Slope: 5 to 45 percent
Depth to restrictive feature: 10 to 20 inches to bedrock (lithic)
Drainage class: Well drained
Ecological site: Sandstone Upland 5-8" p.z.

Persayo and similar soils
Estimated composition: about 5 percent
Slope: 5 to 20 percent
Depth to restrictive feature: 5 to 20 inches to bedrock (paralithic)
Drainage class: Well drained

Note: There are areas with accumulations of large boulders and stones where the upper cap rock has broken off (talus slopes).

17—Razito loamy fine sand, 5 to 45 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,000 to 6,300 feet (1,829 to 1,920 meters)
Mean annual precipitation: 8 to 10 inches (203 to 254 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)
Frost-free period: 100 to 135 days

Map Unit Composition

Razito and similar soils: 95 percent
Minor components: 5 percent

Component Descriptions

Razito soils

Geomorphic position: Dunes
Parent material: Eolian material derived from sandstone
Slope: 5 to 45 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Excessively drained
Slowest permeability: about 6.00 in/hr (rapid)
Available water capacity: Very low (about 2.5 inches)
Shrink-swell potential: Low (about 1.5 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Very low
Calcium carbonate maximum: about 1 percent
Gypsum maximum: None
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 2 SAR (slightly sodic)
Ecological site: Sandy Upland
Present native vegetation: Indian ricegrass, Mormon tea, blue grama, galleta, sand dropseed, broom snakeweed, fourwing saltbush, giant dropseed, rabbitbrush, winterfat
Land capability (nonirrigated): 7c

Figure 9.—Typical landscape of the Benally-Fruitland association, 1 to 5 percent slopes.

Typical Profile:
A—0 to 3 inches; loamy fine sand
C1—3 to 15 inches; fine sand
C2—15 to 44 inches; fine sand
C3—44 to 70 inches; fine sand

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Minor Components

Dunes and similar soils
Estimated composition: about 5 percent
Slope: 5 to 45 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Excessively drained
Ecological site: Sandy Loam Upland 5-8" p.z.

110—Benally-Fruitland association, 1 to 5 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,000 to 6,200 feet (1,829 to 1,890 meters)
Mean annual precipitation: 8 to 10 inches (203 to 254 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)
Frost-free period: 100 to 135 days

Map Unit Composition

Benally and similar soils: 45 percent
Fruitland and similar soils: 40 percent
Minor components: 15 percent

Component Descriptions

Benally soils

Geomorphic position: Stream terraces on valley floors (fig. 9)
Parent material: Stream alluvium derived from sandstone and shale
Slope: 1 to 5 percent
Depth to restrictive feature: Greater than 60 inches to bedrock
Drainage class: Well drained
Slowest permeability: about 0.20 in/hr (slow)
Available water capacity: Moderate (about 6.5 inches)
Shrink-swell potential: Moderate (about 5.0 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Medium
Calcium carbonate maximum: about 10 percent
Gypsum maximum: about 5 percent
Salinity maximum: about 4 mmhos/cm (very slightly saline)
Sodicity maximum: about 30 SAR (strongly sodic)
Ecological site: Loamy Upland (sodic) 5-8" p.z.
Present native vegetation: alkali sacaton, mound saltbush, galleta
Land capability (nonirrigated): 7s

Typical Profile:
A—0 to 1 inches; loamy fine sand
Btn1—1 to 4 inches; fine sandy loam
Btn2—4 to 7 inches; fine sandy loam
Btny1—7 to 13 inches; fine sandy loam
Btny2—13 to 29 inches; clay loam
BC1—29 to 40 inches; sandy clay loam
BC2—40 to 50 inches; clay loam
Cr—50 inches; shale

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Fruitland soils

Geomorphic position: Stream terraces on valley floors
Parent material: Eolian material and stream alluvium derived from sandstone
Slope: 1 to 5 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Well drained
Slowest permeability: about 0.60 in/hr (moderate)
Available water capacity: Low (about 4.1 inches)
Shrink-swell potential: Moderate (about 3.2 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Very low
Calcium carbonate maximum: about 10 percent
Gypsum maximum: about 1 percent
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 5 SAR (slightly sodic)
Ecological site: Sandy Upland 5-8" p.z.
Present native vegetation: Indian ricegrass, blue grama, galleta, fourwing saltbush, winterfat, bottlebrush squirreltail, sand dropseed, broom snakeweed, rabbitbrush
Land capability (nonirrigated): 7c

Typical Profile:
A—0 to 4 inches; loamy fine sand
C1—4 to 20 inches; loamy fine sand
C2—20 to 30 inches; loamy fine sand
Ck1—30 to 40 inches; gravelly sandy clay loam
Ck2—40 to 49 inches; sandy clay loam
Ck3—49 to 58 inches; fine sandy loam
Ck4—58 to 70 inches; fine sandy loam

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Minor Components

Fajada and similar soils
Estimated composition: about 10 percent
Slope: 1 to 5 percent
Depth to restrictive feature: 20 to 40 inches to bedrock (paralithic)
Drainage class: Well drained
Ecological site: Loamy Upland (sodic) 5-8" p.z.

Huerfano and similar soils
Estimated composition: about 5 percent
Slope: 1 to 5 percent
Depth to restrictive feature: 10 to 20 inches to bedrock (paralithic)
Drainage class: Well drained
Ecological site: Loamy Upland (sodic) 5-8" p.z.

115—Razito-Shiprock complex, 3 to 8 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,000 to 6,300 feet (1,829 to 1,920 meters)
Mean annual precipitation: 8 to 10 inches (203 to 254 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)

Frost-free period: 100 to 135 days

Map Unit Composition

Razito and similar soils: 45 percent
Shiprock and similar soils: 40 percent
Minor components: 15 percent

Component Descriptions

Razito soils

Geomorphic position: Fan remnants on valley sides
Parent material: Eolian material derived from sandstone
Slope: 3 to 8 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Excessively drained
Slowest permeability: about 6.00 in/hr (rapid)
Available water capacity: Low (about 3.5 inches)
Shrink-swell potential: Low (about 1.5 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Negligible
Calcium carbonate maximum: about 5 percent
Gypsum maximum: None
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 2 SAR (slightly sodic)
Ecological site: Sandy Upland 5-8" p.z.
Present native vegetation: Indian ricegrass, Mormon tea, blue grama, galleta, sand dropseed, broom snakeweed, fourwing saltbush, giant dropseed, rabbitbrush, winterfat (fig. 10)

Land capability (nonirrigated): 7c

Typical Profile:
A—0 to 4 inches; loamy fine sand
C1—4 to 9 inches; loamy fine sand
C2—9 to 20 inches; loamy fine sand
C3—20 to 24 inches; loamy fine sand
C4—24 to 59 inches; loamy fine sand
C5—59 to 70 inches; fine sand

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Shiprock soils

Geomorphic position: Fan remnants on valley sides
Parent material: Fan alluvium derived from sandstone
Slope: 3 to 8 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Somewhat excessively drained
Slowest permeability: about 2.00 in/hr (moderately rapid)
Available water capacity: Low (about 5.2 inches)
Shrink-swell potential: Low (about 1.7 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Very low
Calcium carbonate maximum: about 15 percent
Gypsum maximum: None
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 2 SAR (slightly sodic)
Ecological site: Sandy Loam Upland 5-8" p.z.

Figure 10.—Typical landscape of the Razito-Shiprock complex, 3 to 8 percent slopes. Fourwing saltbush, sand dropseed, and winterfat are commonly found growing on these soils.

Figure 11.—Typical landscape of Fajada-Huerfano-Benally complex, 1 to 5 percent slopes. These sodium-affected soils are found in the southwestern part of the Park.

Present native vegetation: Indian ricegrass, blue grama, galleta, fourwing saltbush, winterfat, sand dropseed, broom snakeweed, rabbitbrush
Land capability (nonirrigated): 7c

Typical Profile:
A—0 to 2 inches; loamy fine sand
Bw—2 to 6 inches; loamy fine sand
Bt—6 to 12 inches; fine sandy loam
Bk1—12 to 21 inches; fine sandy loam
Bk2—21 to 39 inches; fine sandy loam
Bk3—39 to 55 inches; fine sandy loam
Bk4—55 to 70 inches; loam

Detailed descriptions of specific horizons are available in the "Soil Properties" section and under the heading "Classification of the Soils."

Minor Components

Doak and similar soils
Estimated composition: about 15 percent
Slope: 3 to 8 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Well drained
Ecological site: Loamy Upland 5-8" p.z.

116—Fajada-Huerfano-Benally complex, 1 to 5 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,000 to 6,200 feet (1,829 to 1,890 meters)
Mean annual precipitation: 8 to 10 inches (203 to 254 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)
Frost-free period: 100 to 135 days

Map Unit Composition

Fajada and similar soils: 35 percent
Huerfano and similar soils: 30 percent
Benally and similar soils: 20 percent
Minor components: 15 percent

Component Descriptions

Fajada soils

Geomorphic position: Erosional terraces (fig. 11)
Parent material: Alluvium over residuum derived from sandstone and shale
Slope: 1 to 5 percent
Surface fragments: about 2 percent
Depth to restrictive feature: 20 to 40 inches to bedrock (paralithic)
Drainage class: Well drained
Slowest permeability: about 0.3 in/hr (moderately slow)
Available water capacity: Low (about 4.9 inches)
Shrink-swell potential: Low (about 2.2 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Low
Calcium carbonate maximum: about 10 percent
Gypsum maximum: about 2 percent
Salinity maximum: about 4 mmhos/cm (very slightly saline)
Sodicity maximum: about 30 SAR (strongly sodic)

Ecological site: Loamy Upland (sodic) 5-8" p.z.
Present native vegetation: alkali sacaton, mound saltbush, galleta
Land capability (nonirrigated): 7s

Typical Profile:
A—0 to 3 inches; fine sandy loam
Btn—3 to 9 inches; fine sandy loam
Btkn—9 to 12 inches; sandy clay loam
Bn1—12 to 17 inches; fine sandy loam
Bn2—17 to 28 inches; fine sandy loam
C—28 to 34 inches; loam
Cr—34 inches; shale

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Huerfano soils

Geomorphic position: Erosional terraces
Parent material: Alluvium over residuum derived from sandstone and shale
Slope: 1 to 5 percent
Surface fragments: about 14 percent
Depth to restrictive feature: 4 to 20 inches to bedrock (paralithic)
Drainage class: Well drained
Slowest permeability: about 0.20 in/hr (slow)
Available water capacity: Very low (about 0.8 inches)
Shrink-swell potential: moderate (about 4.5 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Low
Calcium carbonate maximum: about 10 percent
Gypsum maximum: about 2 percent
Salinity maximum: about 4 mmhos/cm (very slightly saline)
Sodicity maximum: about 30 SAR (strongly sodic)
Ecological site: Loamy Upland (sodic) 5-8" p.z.
Present native vegetation: alkali sacaton, mound saltbush, galleta
Land capability (nonirrigated): 7s

Typical Profile:
Btn—0 to 4 inches; clay loam
Cr—4 inches; shale

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Benally soils

Geomorphic position: Erosional terraces and stream terraces
Parent material: Stream alluvium derived from sandstone and shale
Slope: 1 to 5 percent
Surface fragments: about 2 percent
Depth to restrictive feature: Greater than 60 inches to bedrock
Drainage class: Well drained
Slowest permeability: about 0.20 in/hr (slow)
Available water capacity: Low (about 6.0 inches)
Shrink-swell potential: Low (about 1.5 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Low
Calcium carbonate maximum: about 10 percent
Gypsum maximum: about 2 percent
Salinity maximum: about 4 mmhos/cm (very slightly saline)
Sodicity maximum: about 30 SAR (strongly sodic)
Ecological site: Loamy Upland (sodic) 5-8" p.z.
Present native vegetation: alkali sacaton, mound saltbush, galleta
Land capability (nonirrigated): 7s

Typical Profile:
Btn1—0 to 3 inches; clay loam
Btn2—3 to 8 inches; clay loam
Bk1—8 to 13 inches; fine sandy loam
Bk2—13 to 29 inches; fine sandy loam
BCk1—29 to 54 inches; fine sandy loam
BCk2—54 to 62 inches; fine sandy loam
Cr—62 to 65 inches; shale
R—65 inches; hard sandstone bedrock

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Minor Components

Rock outcrop
Estimated composition: about 5 percent
Note: Rock outcrop consists of barren or nearly barren areas of exposed sandstone and shale on ridges, ledges, and escarpments.

Farb and similar soils
Estimated composition: about 5 percent
Slope: 1 to 5 percent
Depth to restrictive feature: 5 to 20 inches to bedrock (lithic)
Drainage class: Somewhat excessively drained
Ecological site: Sandstone Upland

Fruitland and similar soils
Estimated composition: about 5 percent

Figure 12.—Areas of badland occur on the western edge of the Park. Badland consists of raw shale and is typically devoid of vegetation.

Slope: 1 to 5 percent
Depth to restrictive feature: None within 60 inches
Drainage class: Somewhat excessively drained
Ecological site: Sandy Upland 5-8" p.z.

121—Badland

Map Unit Composition

Badland: 90 percent
Minor components: 10 percent

Component Descriptions

Badland

Description: Badland is a miscellaneous area consisting of exposed areas of raw shales of the Menefee formation that is essentially denuded of vegetation. Seams and layers of coal and porcelenite are also included. These areas are highly dissected.

Geomorphic position: Escarpments
Parent material: Unweathered to slightly weathered shale (fig. 12)
Slope: 0 to 200 percent
Depth to restrictive feature: 0 to 2 inches to bedrock (paralithic)
Drainage class: Somewhat excessively drained
Slowest permeability: about 0.00 in/hr (impermeable)
Available water capacity: Very low (about 0.2 inches)
Shrink-swell potential: high (about 7.0 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Very high
Calcium carbonate maximum: about 5 percent
Gypsum maximum: about 5 percent
Salinity maximum: about 4 mmhos/cm (very slightly saline)

Sodicity maximum: about 13 SAR (moderately sodic)
Land capability (nonirrigated): 8

Minor Components

Rock outcrop
Estimated composition: about 10 percent

Rock outcrop consists of barren or nearly barren areas of exposed sandstone and shale on ridges, ledges, and escarpments.

220—Hagerwest-Bond fine sandy loams, 1 to 8 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,700 to 6,900 feet (2,042 to 2,103 meters)
Mean annual precipitation: 10 to 13 inches (254 to 330 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)
Frost-free period: 100 to 135 days

Map Unit Composition

Hagerwest and similar soils: 45 percent
Bond and similar soils: 40 percent
Minor components: 15 percent

Component Descriptions

Hagerwest soils

Geomorphic position: Summits on mesas
Parent material: Eolian material and slope alluvium derived from sandstone and shale
Slope: 1 to 8 percent
Depth to restrictive feature: 20 to 40 inches to bedrock (lithic)
Drainage class: Well drained
Slowest permeability: about 0.60 in/hr (moderate)
Available water capacity: Low (about 3.1 inches)
Shrink-swell potential: Moderate (about 4.5 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Medium
Calcium carbonate maximum: about 2 percent
Gypsum maximum: None
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 0 SAR (nonsodic)
Ecological site: Loamy
Present native vegetation: blue grama, western wheatgrass, alkali sacaton, bottlebrush squirreltail, fourwing saltbush, galleta, winterfat, oneseed juniper, broom snakeweed, rabbitbrush
Land capability (nonirrigated): 7c

Typical Profile:
A—0 to 2 inches; fine sandy loam
Bt1—2 to 7 inches; sandy clay loam
Bt2—7 to 13 inches; sandy clay loam
BC—13 to 21 inches; sandy clay loam
R—21 inches; hard sandstone bedrock

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Bond soils

Geomorphic position: Summits on mesas
Parent material: Eolian material and slope alluvium derived from sandstone
Slope: 1 to 8 percent
Surface fragments: about 3 percent
Depth to restrictive feature: 10 to 20 inches to bedrock (lithic)
Drainage class: Well drained
Slowest permeability: about 0.60 in/hr (moderate)
Available water capacity: Very low (about 2.1 inches)
Shrink-swell potential: Low (about 1.5 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: High
Calcium carbonate maximum: about 5 percent
Gypsum maximum: None
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 0 SAR (nonsodic)
Ecological site: Shallow Sandstone
Present native vegetation: Bigelow sagebrush, blue grama, fourwing saltbush, Indian ricegrass, galleta, winterfat, Mormon tea, cliffrose, oneseed juniper, twoneedle pinyon
Land capability (nonirrigated): 7c

Typical Profile:
A—0 to 3 inches; fine sandy loam
Btk—3 to 10 inches; fine sandy loam
Bk—10 to 15 inches; fine sandy loam
R—15 inches; hard sandstone bedrock

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Minor Components

Farb and similar soils
Estimated composition: about 10 percent

Slope: 1 to 8 percent
Depth to restrictive feature: 10 to 20 inches to bedrock (lithic)

Rock outcrop
Estimated composition: about 5 percent

Rock outcrop consists of barren or nearly barren areas of exposed sandstone and shale on ridges, ledges, and escarpments.

250—Hospah-Skyvillage-Rock outcrop complex, 2 to 35 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,400 to 6,800 feet (1,951 to 2,073 meters)
Mean annual precipitation: 10 to 13 inches (203 to 254 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)
Frost-free period: 100 to 135 days

Map Unit Composition

Hospah and similar soils: 35 percent
Skyvillage and similar soils: 30 percent
Rock outcrop: 25 percent
Minor components: 10 percent

Component Descriptions

Hospah soils

Geomorphic position: Escarpments on cuestas and mesas
Parent material: Colluvium over residuum derived from shale and sandstone
Slope: 2 to 35 percent
Surface fragments: about 10 percent
Depth to restrictive feature: 5 to 20 inches to bedrock (paralithic)
Drainage class: Well drained
Slowest permeability: about 0.06 in/hr (slow)
Available water capacity: Very low (about 2.4 inches)
Shrink-swell potential: High (about 7.5 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Very high
Calcium carbonate maximum: about 5 percent
Gypsum maximum: about 5 percent
Salinity maximum: about 4 mmhos/cm (very slightly saline)
Sodicity maximum: about 10 SAR (slightly sodic)
Ecological site: Shale Hills
Present native vegetation: galleta, fourwing saltbush, sideoats grama, western wheatgrass, mound saltbush, Bigelow sagebrush, oneseed juniper
Land capability (nonirrigated): 7e

Typical Profile:
A—0 to 3 inches; clay loam
C—3 to 15 inches; clay
Cr—15 inches; shale

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Skyvillage soils

Geomorphic position: Structural benches on escarpments
Parent material: Eolian material and slope alluvium derived from sandstone
Slope: 2 to 20 percent
Surface fragments: about 16 percent
Depth to restrictive feature: 6 to 20 inches to bedrock (lithic)
Drainage class: Well drained
Slowest permeability: about 2.00 in/hr (moderately rapid)
Available water capacity: Very low (about 0.9 inches)
Shrink-swell potential: Low (about 0.0 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Very high
Calcium carbonate maximum: about 10 percent
Gypsum maximum: about 1 percent
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 0 SAR (nonsodic)
Ecological site: Shallow Sandstone
Present native vegetation: Bigelow sagebrush, blue grama, fourwing saltbush, Indian ricegrass, mountain mahogany, galleta, little bluestem, sideoats grama, winterfat, Mormon tea, cliffrose, oneseed juniper, twoneedle pinyon
Land capability (nonirrigated): 7s

Typical Profile:
A—0 to 1 inches; gravelly loamy fine sand
C—1 to 7 inches; fine sandy loam
R—7 inches; hard sandstone bedrock

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Rock outcrop

Rock outcrop consists of barren or nearly barren areas of exposed sandstone and shale on ridges, ledges, and escarpments.

Minor Components

Hagerwest and similar soils
Estimated composition: about 5 percent
Slope: 1 to 5 percent
Depth to restrictive feature: 20 to 40 inches to bedrock (lithic)
Ecological site: Loamy

Bond and similar soils
Estimated composition: about 5 percent
Slope: 1 to 5 percent
Depth to restrictive feature: 5 to 20 inches to bedrock (lithic)
Ecological site: Shallow Sandstone

290—Rock outcrop-Westmion-Skyvillage complex, 30 to 80 percent slopes

Map Unit Setting

MLRA: 35
Elevation: 6,400 to 6,800 feet (1,951 to 2,073 meters)
Mean annual precipitation: 10 to 13 inches (203 to 254 millimeters)
Mean annual air temperature: 48 to 50 degrees F (9 to 10 degrees C)
Frost-free period: 100 to 135 days

Map Unit Composition

Rock outcrop: 45 percent
Westmion and similar soils: 25 percent
Skyvillage and similar soils: 20 percent
Minor components: 10 percent

Component Descriptions

Rock outcrop

Rock outcrop consists of barren or nearly barren areas of exposed sandstone and shale on ridges, ledges, and escarpments.

Westmion soils

Geomorphic position: Escarpments on cuestas and mesas
Parent material: Slope alluvium and colluvium over residuum derived from shale
Slope: 30 to 50 percent
Surface fragments: about 15 percent
Depth to restrictive feature: 6 to 20 inches to bedrock (paralithic)
Drainage class: Well drained
Slowest permeability: about 0.06 in/hr (slow)
Available water capacity: Very low (about 1.3 inches)
Shrink-swell potential: High (about 7 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Very high
Calcium carbonate maximum: about 5 percent
Gypsum maximum: about 2 percent
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 5 SAR (slightly sodic)
Ecological site: Foothills
Present native vegetation: blue grama, cliffrose, fourwing saltbush, galleta, oneseed juniper, twoneedle pinyon
Land capability (nonirrigated): 7e

Typical Profile:
A—0 to 2 inches; gravelly clay loam
C—2 to 8 inches; clay
Cr—8 inches; shale

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Skyvillage soils

Geomorphic position: Structural benches on escarpments
Parent material: Eolian material and slope alluvium derived from sandstone
Slope: 2 to 20 percent
Surface fragments: about 61 percent
Depth to restrictive feature: 10 to 20 inches to bedrock (lithic)
Drainage class: Well drained
Slowest permeability: about 2.00 in/hr (moderately rapid)
Available water capacity: Very low (about 1.3 inches)
Shrink-swell potential: Low (about 1.5 LEP)
Flooding hazard: None
Ponding hazard: None
Seasonal water table minimum depth: Greater than 6 feet
Runoff class: Medium
Calcium carbonate maximum: about 10 percent
Gypsum maximum: about 1 percent
Salinity maximum: about 2 mmhos/cm (nonsaline)
Sodicity maximum: about 0 SAR (nonsodic)
Ecological site: Shallow Sandstone
Present native vegetation: Bigelow sagebrush, blue grama, fourwing saltbush, Indian ricegrass, wolfberry, little bluestem, sideoats grama,

winterfat, mountain mahogany, Mormon tea, cliffrose, oneseed juniper, twoneedle pinyon
Land capability (nonirrigated): 7c

Typical Profile:
A—0 to 3 inches; extremely gravelly sandy loam
C—3 to 11 inches; gravelly sandy loam
R—11 inches; hard sandstone bedrock

Detailed descriptions of specific horizons are available in the “Soil Properties” section and under the heading “Classification of the Soils.”

Minor Components

Hospah and similar soils
Estimated composition: about 6 percent
Slope: 30 to 80 percent
Depth to restrictive feature: 5 to 20 inches to bedrock (paralithic)
Drainage class: Well drained
Ecological site: Shale Hills

Vessilla and similar soils
Estimated composition: about 4 percent
Slope: 5 to 15 percent
Depth to restrictive feature: 5 to 20 inches to bedrock (lithic)
Drainage class: Somewhat excessively drained
Ecological site: Shallow Sandstone

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for rangeland as sites for buildings, sanitary facilities, transportation systems, recreational facilities; for waste management; and as wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

This survey can be used to locate sources of sand and gravel, roadfill, and topsoil. It can be used to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

The National Park Service, health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, and campgrounds.

Interpretive Ratings

The interpretive tables in this survey rate the soils in the survey area for various uses. Many of the tables identify the limitations that affect specified uses and indicate the severity of those limitations. The ratings in these tables are both verbal and numerical.

Rating Class Terms

Rating classes are expressed in the tables in terms that indicate the extent to which the soils are limited by all of the soil features that affect a specified use or in terms that indicate the suitability of the soils for the use. The tables may show limitation classes or suitability classes. Terms for the limitation classes are not limited, slightly limited, somewhat limited, and very limited. The suitability ratings are expressed as well suited, moderately well suited, poorly suited, and unsuited or as good, fair, and poor.

Numerical Ratings

Numerical ratings in the tables indicate the relative severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.00 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use and the point at which the soil feature is not a limitation. The limitations appear in order from the most limiting to the least limiting. If more than one limitation is identified, the most severe limitation is listed first and the least severe one is listed last.

Prime Farmland

According to the criteria developed by the United State Department of Agriculture, there is no prime farmland within the Park boundaries. The main reasons are a lack of an adequate and dependable supply of moisture from precipitation or irrigation and areas that flood frequently.

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation’s short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation’s prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing

food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forestland, or other land, but it is not urban or built-up land or water areas. The soil qualities, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management, and acceptable farming methods are applied. In general, prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. It is permeable to water and air. It is not excessively erodible or saturated with water for long periods and it either is not frequently flooded during the growing season or is protected from flooding. Slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops (USDA, 1961). Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, forestland, or for engineering purposes.

Land capability classifications for the individual soils in this survey can be found in the “Detailed Soil Map Units” section.

In the capability system, soils are generally grouped at two levels, capability class and subclass.

The numbers 1 through 8 designate capability classes, the broadest groups. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have slight limitations that restrict their use.

Class 2 soils have moderate limitations that restrict the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that restrict the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that restrict the choice of plants or that require very careful management, or both.

Class 5 soils are subject to little or no erosion but have other limitations, impractical to remove, that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.

Class 7 soils have very severe limitations that make them unsuitable for cultivation and that restrict their use mainly to grazing, forestland, or wildlife habitat.

Class 8 soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed, or esthetic purposes.

Capability subclasses are soil groups within one class. They are designated by adding a small letter *e, w, s,* or *c,* to the class numeral, for example, 2e. The letter *e* specifies that the main hazard is the risk of erosion unless close-growing plant cover is maintained. Subclass *w* specifies that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage). Subclass *s* specifies that the soil is limited mainly because it is shallow, droughty, or stony; and subclass *c,* used in parts of the United States, shows that the chief limitation is climate (very cold or very dry).

In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *w, s,* or *c* because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, forestland, wildlife habitat, or recreation.

Rangeland

In areas that have similar climate and topography, differences in the kind and amount of rangeland or forest understory vegetation are closely related to the kind of soil. Effective management is based on the relationship between the soils, vegetation and water.

The ecological site description shows the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Explanations of the column headings in table 5 follow.

An ecological site is the product of all the environmental factors responsible for its development. It has characteristic soils that have developed over time throughout the soil development process; a characteristic hydrology, particularly infiltration and runoff, that has developed over time; and a characteristic plant community (kind and amount of vegetation). The hydrology of the site is influenced by development of the soil and plant community. The vegetation, soils, and hydrology are all interrelated. Each is influenced by the others and influences the development of the others. An association of species that differs from that of other ecological sites in the kind and/or proportion of species or in total production typifies the plant community on an ecological site. Descriptions of ecological sites are provided in the Field Office Technical Guide, which is available in local offices of the Natural Resources Conservation Service.

Total dry-weight production is the amount of vegetation that can be expected to grow annually in a well-managed area that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperature make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture. Yields are adjusted to a common percent of air-dry moisture content.

Characteristic vegetation; the grasses, forbs, and shrubs, that make up most of the potential natural plant community on each soil is listed by common name. Under rangeland composition, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range similarity index and rangeland trend. Range similarity index is determined by comparing the present plant community with the potential natural plant community on a particular rangeland ecological site. The more closely the existing community resembles the potential community, the higher the range similarity index. Rangeland trend is defined as the direction of change in an existing plant community relative to the potential natural plant community. Further information about the range similarity index and rangeland trend is available in chapter 4 of the National Range and Pasture Handbook, which is available in local offices of the Natural Resources Conservation Service.

The objective in range management is to provide conditions so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, an area that has a range similarity index somewhat below the potential, provides adequate wildlife habitat, and protects soil and water resources.

Recreation

Chaco Culture National Historical Park is a place of scenic, geologic, and historic interest. The Park is a good place for hiking, sightseeing, and photography.

The soils of the survey area are rated in table 6a and table 6b according to limitations that affect their suitability for recreation. The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the recreational uses. Not limited indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. Slightly limited indicates that the soil has features that are favorable for the specified use. The limitations are minor and can be easily overcome. Good performance and low maintenance can be expected. Somewhat limited indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. Very limited indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the tables indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.00 to 1.00. They indicate gradations between the point at which a soil

feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The ratings in the tables are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation also are important. Soils that are subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential. The information in tables 6a and table 6b can be supplemented by other information in this survey, for example, interpretations for building site development, construction materials, sanitary facilities, and water management.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The ratings are based on the soil properties that affect the ease of developing camp areas and the performance of the areas after development. Slope, stoniness, and depth to bedrock or a cemented pan are the main concerns affecting the development of camp areas.

The soil properties that affect the performance of the areas after development are those that influence trafficability and promote the growth of vegetation, especially in heavily used areas. For good trafficability, the surface of camp areas should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry. The soil properties that influence trafficability are texture of the surface layer, depth to a water table, ponding, flooding, permeability, and large stones. The soil properties that affect the growth of plants are depth to bedrock or a cemented pan, permeability, and toxic substances in the soil.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The ratings are based on the soil properties that affect the ease of developing picnic areas and that influence trafficability and the growth of vegetation after development. Slope and stoniness are the main concerns affecting the development of picnic areas. For good trafficability, the surface of picnic areas should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry. The soil properties that influence trafficability are texture of the surface layer, depth to a water table, ponding, flooding, permeability, and large stones. The soil properties that affect the growth of plants are depth to bedrock or a cemented pan, permeability, and toxic substances in the soil.

Playgrounds require soils that are nearly level, are free of stones, and can withstand intensive foot traffic. The ratings are based on the soil properties that affect the ease of developing playgrounds and that influence trafficability and the growth of vegetation after development. Slope and stoniness are the main concerns affecting the development of playgrounds. For good trafficability, the surface of the playgrounds should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry. The soil properties that influence trafficability are texture of the surface layer, depth to a water table, ponding, flooding, permeability, and large stones. The soil properties that affect the growth of plants are depth to bedrock or a cemented pan, permeability, and toxic substances in the soil.

Paths and trails for hiking and horseback riding should require little or no slope modification through cutting and filling. The ratings are based on the soil properties that affect trafficability and erodibility. These properties are stoniness, depth to a water table, ponding, flooding, slope, and texture of the surface layer.

Off-road vehicle areas require little or no site preparation. They are not covered with surfacing material or vegetation. Considerable compaction of the soil material is likely. The ratings are based on the soil properties that influence erodibility, trafficability, dustiness, and the ease of revegetation. These properties are stoniness, slope, depth to a water table, ponding, flooding, and texture of the surface layer.

Grassed walkways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. Irrigation is not considered in the ratings. The ratings are based on the soil properties that affect plant growth and trafficability after vegetation is established. The properties that affect plant growth are reaction; depth to a water table; ponding; depth to bedrock or a cemented pan; the available water capacity in the upper 40 inches; the content of salts, sodium, or calcium carbonate; and sulfidic materials. The properties that affect trafficability are flooding, depth to a water table, ponding, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer. The suitability of the soil for traps, tees, roughs, and greens is not considered in the ratings.

Wildlife Habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

The Park is host to a variety of wildlife. A resident elk herd numbering approximately 33 animals inhabits the higher elevations on Chaco Mesa during the day, then comes down into Chaco Wash during the evening and night hours. Mule deer can be seen on Chaco Mesa and on the lower mesas to the west. Other wildlife seen within the Park are bobcats, jackrabbits, cottontails, lizards, prairie rattlesnakes, ground squirrels, a variety of insects and birds, and of course, the ubiquitous coyote.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the “Soil Properties” section. Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil between the surface and a depth of 5 to 7 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil. The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design. Soil properties, site features, and observed performance were considered in determining the ratings in this section.

During the fieldwork for this soil survey, determinations were made about particle-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 7 feet of the surface, soil wetness, depth to a water table, ponding, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils. The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations. Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Soil properties influence the development of building sites, including the selection of the site, the design of the structure, construction, performance after construction, and maintenance. Table 7a and table 7b show the degree and kind of soil limitations that affect dwellings with and without basements, small commercial buildings, local roads and streets, shallow excavations, and lawns and landscaping.

The ratings in the tables are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect building site development. Not limited indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. Slightly limited indicates that the soil has features that are favorable for the specified use. The limitations are minor and can be easily overcome. Good performance and low

maintenance can be expected. Somewhat limited indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. Very limited indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the tables indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.00 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Dwellings are single-family houses of three stories or less. For dwellings without basements, the foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of 2 feet or at the depth of maximum frost penetration, whichever is deeper. For dwellings with basements, the foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of about 7 feet. The ratings for dwellings are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding, flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility. Compressibility is inferred from the Unified classification. The properties that affect the ease and amount of excavation include depth to a water table, ponding, flooding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

Small commercial buildings are structures that are less than three stories high and do not have basements. The foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of 2 feet or at the depth of maximum frost penetration, whichever is deeper. The ratings are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding, flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility (which is inferred from the Unified classification). The properties that affect the ease and amount of excavation include flooding, depth to a water table, ponding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or soil material stabilized by lime or cement; and a surface of flexible material (asphalt), rigid material (concrete), or gravel with a binder. The ratings are based on the soil properties that affect the ease of excavation and grading and the traffic-supporting capacity. The properties that affect the ease of excavation and grading are depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, depth to a water table, ponding, flooding, the amount of large stones, and slope. The properties that affect the traffic-supporting capacity are soil strength (as inferred from the AASHTO group index number), subsidence, linear extensibility (shrink-swell potential), the potential for frost action, depth to a water table, and ponding.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for graves, utility lines, open ditches, or other purposes. The ratings are based on the soil properties that influence the ease of digging and the resistance to sloughing. Depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, the amount of large stones, and dense layers influence the ease of digging, filling, and compacting. Depth to the seasonal high water table, flooding, and ponding may restrict the period when excavations can be made. Slope influences the ease of using machinery. Soil texture, depth to the water table, and linear extensibility (shrink-swell potential) influence the resistance to sloughing.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. Irrigation is not considered in the ratings. The ratings are based on the soil properties that affect plant growth and trafficability after vegetation is established. The properties that affect plant growth are reaction; depth to a water table; ponding; depth to bedrock or a cemented pan; the available water capacity in the upper 40 inches; the content of salts, sodium, or calcium carbonate; and sulfidic materials. The properties that affect trafficability are flooding, depth to a water table, ponding, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer.

Sanitary Facilities

Table 8a and table 8b show the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, sanitary landfills, and daily cover for landfills. The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect these uses. Not limited indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. Slightly limited indicates that the soil has features that are favorable for the specified use. The limitations are minor and can be easily overcome. Good performance and low maintenance can be expected. Somewhat limited indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. Very limited indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings in the tables indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.00 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 60 inches is evaluated. The ratings are based on the soil properties that affect absorption of the effluent, construction and maintenance of the system, and public health. Permeability, depth to a water table, ponding, depth to bedrock or a cemented pan, and flooding affect absorption of the effluent. Stones and boulders, ice, and bedrock or a cemented pan interfere with installation. Subsidence interferes with installation and maintenance. Excessive slope may cause lateral seepage and surfacing of the effluent in downslope areas.

Some soils are underlain by loose sand and gravel or fractured bedrock at a depth of less than 4 feet below the distribution lines. In these soils the absorption field may not adequately filter the effluent, particularly when the system is new. As a result, the ground water may become contaminated.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic or anaerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water. Considered in the ratings are slope, permeability, depth to a water table, ponding, depth to bedrock or a cemented pan, flooding, large stones, and content of organic matter.

Soil permeability is a critical property affecting the suitability for sewage lagoons. Most porous soils eventually become sealed when they are used as sites for sewage lagoons. Until sealing occurs, however, the hazard of pollution is severe. Soils that have a permeability rate of more than 2 inches per hour are too porous for the proper functioning of sewage lagoons. In these soils, seepage of the effluent can result in contamination of the ground water. Groundwater contamination is also a hazard if fractured bedrock is within a depth of 40 inches, if the water table is high enough to raise the level of sewage in the lagoon, or if floodwater overtops the lagoon.

A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor. If the lagoon is to be uniformly deep throughout, the slope must be gentle enough and the soil material must be thick enough over bedrock or a cemented pan to make land smoothing practical.

A trench sanitary landfill is an area where solid waste is placed in successive layers in an excavated trench. The waste is spread, compacted, and covered daily with a thin layer of soil excavated at the site. When the trench is full, a final cover of soil material at least 2 feet thick is placed over the landfill. The ratings in the table are based on the soil properties that affect the risk of pollution, the ease of excavation, trafficability, and revegetation. These properties include permeability, depth to bedrock or a cemented pan, depth to a water table, ponding, slope, flooding, texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, onsite investigation may be needed.

Hard, nonrippable bedrock, creviced bedrock, or highly permeable strata in or directly below the proposed trench bottom can affect the ease of excavation and the hazard of groundwater pollution. Slope affects construction of the trenches and the

movement of surface water around the landfill. It also affects the construction and performance of roads in areas of the landfill.

Soil texture and consistence affect the ease with which the trench is dug and the ease with which the soil can be used as daily or final cover. They determine the workability of the soil when dry and when wet. Soils that are plastic and sticky when wet are difficult to excavate, grade, or compact and are difficult to place as a uniformly thick cover over a layer of refuse.

The soil material used as the final cover for a trench landfill should be suitable for plants. It should not have excess sodium or salts and should not be too acid. The surface layer generally has the best workability, the highest content of organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

In an area sanitary landfill, solid waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site. A final cover of soil material at least 2 feet thick is placed over the completed landfill. The ratings in the table are based on the soil properties that affect trafficability and the risk of pollution. These properties include flooding, permeability, depth to a water table, ponding, slope, and depth to bedrock or a cemented pan.

Flooding is a serious problem because it can result in pollution in areas downstream from the landfill. If permeability is too rapid or if fractured bedrock, a fractured cemented pan, or the water table is close to the surface, the leachate can contaminate the water supply. Slope is a consideration because of the extra grading required to maintain roads in the steeper areas of the landfill. Also, leachate may flow along the surface of the soils in the steeper areas and cause difficult seepage problems.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste. The ratings in the table also apply to the final cover for a landfill. They are based on the soil properties that affect workability, the ease of digging, and the ease of moving and spreading the material over the refuse daily during wet and dry periods. These properties include soil texture, depth to a water table, ponding, rock fragments, slope, depth to bedrock or a cemented pan, reaction, and content of salts, sodium, or lime.

Loamy or silty soils that are free of large stones and excess gravel are the best cover for a landfill. Clayey soils may be sticky and difficult to spread; sandy soils are subject to wind erosion.

Slope affects the ease of excavation and of moving the cover material. It can also influence runoff, erosion, and reclamation of the borrow area.

After removal of borrow material, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. It should not have excess sodium, salts, or lime, and it should not be too acid.

Construction Materials

Table 9a and table 9b give information about the soils as potential sources of gravel, sand, topsoil, reclamation material, and roadfill. Normal compaction, minor processing, and other standard construction practices are assumed.

The soils are rated good, fair, or poor as potential sources of topsoil, reclamation material, and roadfill. The features that limit the soils as sources of these materials are specified in the tables. The numerical ratings given after the specified features indicate the degree to which the features limit the soils as sources of topsoil, reclamation material, or roadfill. The lower the number, the greater the limitation.

The soils are rated as a probable or improbable source of sand and gravel. A rating of probable means that the source material is likely to be in or below the soil. The numerical ratings in these columns indicate the degree of probability. The number 0.00 indicates that the soil is an improbable source. A number between 0.00 and 1.00 indicates the degree to which the soil is a probable source of sand or gravel.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 9a, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material. The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the Unified classification of the soil), the thickness of suitable material, and the content of rock fragments. If the lowest layer of the soil contains sand or gravel, the soil is rated as a probable source regardless of thickness. The assumption is that the sand or gravel layer below the depth of observation exceeds the minimum thickness.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area. The ratings are based on the soil properties that affect plant growth; the ease of excavating, loading, and spreading the material; and reclamation of the borrow area. Toxic substances, soil reaction, and the properties that are inferred from soil texture, such as available water capacity and fertility, affect plant growth. Rock fragments, slope, depth to water table, soil texture and thickness of suitable material affect the ease of excavating, loading, and spreading. Reclamation of the borrow area is affected by slope, depth to a water table, rock fragments, depth to bedrock or a cemented pan, and toxic material.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Reclamation material is used in areas that have been drastically disturbed by surface mining or similar activities. When these areas are reclaimed, layers of soil material or unconsolidated geological material, or both, are replaced in a vertical sequence. The reconstructed soil favors plant growth. The ratings in the table do not apply to quarries and other mined areas that require an offsite source of reconstruction material. The ratings are based on the soil properties that affect erosion and stability of the surface and the productive potential of the reconstructed soil. These properties include the content of sodium, salts, and calcium carbonate; reaction; available water capacity; erodibility; texture; content of rock fragments; and content of organic matter and other features that affect fertility.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the whole soil, from the surface to a depth of about 5 feet. It is assumed that soil layers will be mixed when the soil material is excavated and spread.

The ratings are based on the amount of suitable material and on soil properties that affects the ease of excavation and the performance of the material after it is in place. The thickness of the suitable material is a major consideration. Large stones, depth to water table and slope affect the ease of excavation. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the AASHTO classification of the soil) and linear extensibility (shrink-swell potential).

Water Management

Table 10 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered slight if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome. Moderate limitations exist if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations. Severe limitations exist if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high

content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a groundwater aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, a cemented pan, or other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, and sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. Large stones and depth to bedrock or a cemented pan affect the construction of a system. The depth of the root zone, the amount of salts or sodium, and soil reaction, affect the performance of a system.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, which conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts and sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. Soil properties are ascertained by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed (USDA, 1996). During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine particle-size distribution, plasticity, and compaction characteristics. Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils. The estimates of soil properties are shown in tables. They include engineering index properties, physical and chemical properties, and pertinent soil and water features.

Engineering Index Properties

Table 11 gives the engineering classifications and the range of index properties for the layers of each soil in the survey area.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. “Loam,” for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than 2 millimeters is 15 percent or more, an appropriate modifier is added, for example, “gravelly.” Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (ASTM, 1998) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1998).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and plasticity index (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of particle-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries,

the classification in the marginal zone is generally omitted in the table.

Physical Properties

Table 12 shows estimates of some physical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Particle size is the effective diameter of a soil particle as measured by sedimentation, sieving, or micrometric methods. Particle sizes are expressed as classes with specific effective diameter class limits. The broad classes are sand, silt, and clay, ranging from the larger to the smaller.

Clay consists of mineral soil particles that are less than 0.002 millimeters in diameter. In table 12, the estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of sand, silt, and clay affects the physical behavior of a soil. Particle size is important for engineering and agronomic interpretations, for determination of soil hydrologic qualities, and for soil classification.

The amount and kind of clay affects the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affects tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 or 1/10 bar (33kPa or 10kPa) moisture tension. Weight is determined after the soil is dried at 105 degrees C. In the table, the estimated moist bulk density of each soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data is used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. Depending on soil texture, a bulk density of more than 1.4 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability (Ksat) refers to the ability of a soil to transmit water or air. The term “permeability,” as used in soil surveys, indicates saturated hydraulic conductivity (Ksat). The estimates in the table indicate the rate of water movement, in inches per hour, when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Linear extensibility refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. It is an expression of the volume change between the water content of the clod at 1/3 or 1/10 bar tension (33kPa or 10kPa tension) and oven dryness. The volume change is reported in the table as percent change for the whole soil. The amount and type of clay minerals in the soil influence volume change.

Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3 percent; moderate if 3 to 6 percent; high if 6 to 9 percent; and very high if more than 9 percent. If the linear extensibility is more than 3, shrinking and swelling can cause damage to buildings, roads, and other structures and to plant roots. Special design commonly is needed.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 12, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained by returning crop residue to the soil. Organic matter has a positive effect on available water capacity, water infiltration, soil organism activity, and tilth. It is a source of nitrogen and other nutrients for crops and soil organisms.

Erosion factors are shown in table 12 as the K

factor (Kw and Kf) and the T factor. Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of several factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and permeability. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor Kw indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are as follows:

1. Coarse sands, sands, fine sands, and very fine sands.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.

8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

Wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that is expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Chemical Properties

Table 13 shows estimates of some chemical characteristics and features that affect soil behavior. These estimates are given for the layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated.

Cation-exchange capacity is the total amount of extractable bases that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. Soils having a low cation-exchange capacity hold fewer cations and may require more frequent applications of fertilizer than soils having a high cation-exchange capacity. The ability to retain cations reduces the hazard of ground-water pollution.

Effective cation-exchange capacity refers to the sum of extractable bases plus aluminum expressed in terms of milliequivalents per 100 grams of soil. It is determined for soils that have pH of less than 5.5.

Soil reaction is a measure of acidity or alkalinity. The pH of each soil horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Calcium carbonate equivalent is the percent of carbonates, by weight, in the fraction of the soil less than 2 millimeters in size. The availability of plant nutrients is influenced by the amount of carbonates in the soil. Incorporating nitrogen fertilizer into calcareous soils helps to prevent nitrite accumulation and ammonium-N volatilization.

Gypsum is expressed as a percent, by weight, of hydrated calcium sulfates in the fraction of the soil less than 20 millimeters in size. Gypsum is partially soluble in water. Soils that have a high content of gypsum may collapse if the gypsum is removed by percolating water.

Salinity is a measure of soluble salts in the soil at

saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Sodium adsorption ratio (SAR) is a measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. Soils that have SAR values of 13 or more may be characterized by an increased dispersion of organic matter and clay particles, reduced permeability and aeration, and a general degradation of soil structure.

Soil Features

Table 14 gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

A restrictive layer is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers. The table indicates the hardness and thickness of the restrictive layer, both of which significantly affect the ease of excavation. Depth to top is the vertical distance from the soil surface to the upper boundary of the restrictive layer.

Potential for frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well-drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel or concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel or concrete in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion for uncoated steel is expressed as low, moderate, or high. It is based on soil drainage class, total acidity, electrical resistivity at or near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as low, moderate, or high. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Water Features

Table 15 gives estimates of various water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a

layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.

The months in the table indicate the portion of the year in which the feature is most likely to be a concern.

Water table refers to a saturated zone in the soil. Table 15 indicates, by month, depth to the top (upper limit) and base (lower limit) of the saturated zone in most years. Estimates of the upper and lower limits are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

Ponding is standing water in a closed depression. Unless a drainage system is installed, only percolation, transpiration, or evaporation removes the water. Table 15 indicates surface water depth and the duration and frequency of ponding. Duration is expressed as very brief if less than 2 days, brief if 2 to 7 days, long if 7 to 30 days, and very long if more than 30 days. Frequency is expressed as none, rare, occasional, and frequent. None means that ponding is not probable. Rare means that it is unlikely but possible under unusual weather conditions (the chance of ponding is nearly 0 to 5 percent in any year). Occasional means that it occurs, on average, once or less in 2 years (the chance of ponding is 5 to 50 percent in any year). Frequent means that it occurs, on average, more than once in 2 years (the chance of ponding is more than 50 percent in any year).

Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Duration and frequency are estimated. Duration is expressed as extremely brief if 0.1 hour to 4 hours, very brief if 4 hours to 2 days, brief if 2 to 7 days, long if 7 to 30 days, and very long if more than 30 days. Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent. None means that flooding is not probable; very rare that it is very unlikely but possible under extremely unusual weather conditions (the chance of flooding is less than 1 percent in any year). Rare means that it is unlikely but possible under unusual weather conditions (the chance of flooding is 1 to 5 percent in any year); occasional that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year). Frequent means that it is likely to occur often under normal weather conditions (the chance of flooding is more than 50 percent in any year but is less than 50 percent in all months in any year). Very frequent means that it is likely to occur very often under normal weather conditions (the chance of flooding is more than 50 percent in all months of any year).

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (USDA, 1998 and 1999). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 16 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Twelve soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in sol. An example is Aridisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Argid (Arg, meaning presence of argillic horizon, plus id, from Aridisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; type of saturation; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplargids (Hapl, meaning minimal horizonation, plus argid, the suborder of the Aridisols that has a argillic horizon).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic subgroup is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other taxonomic class. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective Typic identifies the subgroup that typifies the great group. An example is Typic Haplargids.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle size, mineral content, soil temperature regime, soil depth, and reaction. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, active, mesic Typic Haplargids.

SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The Doak series is an example of a fine-loamy, mixed, active, mesic Typic Haplargid.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil that is typical of the series in the survey area, is described. The detailed description of each soil horizon follows standards in the “Soil Survey Manual” (USDA, 1993). Many of the technical terms used in the descriptions are defined in “Soil Taxonomy” (USDA, 1999) and in “Keys to Soil Taxonomy” (USDA, 1998). Unless otherwise indicated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

Battlerock Series

Taxonomic class: Fine-loamy, mixed, superactive, calcareous, mesic Typic Torrifluvents
Depth class: Very deep

Drainage class: Well drained
Permeability: Slow
Geomorphic position: Stream terraces
Parent material: Stream alluvium derived from sandstone and shale
Slope range: 0 to 1 percent
Elevation: 6,000 to 6,300 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 8 to 10 inches
Frost-free period: 100 to 135 days

Typical Pedon

Battlerock fine sandy loam, in an area of mapping unit 2, Battlerock-Notal complex, 0 to 1 percent slopes; San Juan County, New Mexico; Pueblo Bonito Quadrangle; 1,400 feet west and 400 feet south of the northeast corner of sec. 29, T. 21 N., R. 10 W.; UTM: 13S 02-37-281, 39-90-982.

A—0 to 3 inches; light yellowish brown (2.5Y 6/3) fine sandy loam, light olive brown (2.5Y 5/3) moist; weak very fine granular structure; soft, loose, nonsticky and nonplastic; many very fine roots; very slightly effervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.

Bw—3 to 7 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; weak very fine and fine subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine roots; common very fine and few fine irregular pores; very slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

C1—7 to 11 inches; light yellowish brown (2.5Y 6/3) stratified clay loam, light olive brown (2.5Y 5/3) moist; moderate thin and medium platy structure; hard, friable, sticky and plastic; many very fine strata of silt and very fine sand; many very fine roots; common very fine irregular pores; very slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

C2—11 to 17 inches; light yellowish brown (2.5Y 6/3) stratified loam, light olive brown (2.5Y 5/3) moist; moderate thin and medium platy and moderate very fine and fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine strata of silt and very fine sand; few very fine roots; common very fine irregular pores; very slightly effervescent; slightly alkaline (pH 8.0); abrupt smooth boundary.

Cy1—17 to 23 inches; light yellowish brown (2.5Y 6/3) stratified clay loam, light olive brown (2.5Y 5/3) moist; weak very thin and thin platy structure; hard, firm, sticky and plastic; many very fine strata of silt and very fine sand; common very fine roots; few very fine irregular pores; few very fine masses of gypsum; very slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Cy2—23 to 35 inches; light yellowish brown (2.5Y 6/3) sandy clay loam, light olive brown (2.5Y 5/3) moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine irregular pores; few very fine masses of gypsum; very slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Cy3—35 to 42 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; massive; very hard, very firm, slightly sticky and slightly plastic; few very fine roots; few very fine irregular pores; common distinct yellowish brown relict redoximorphic concentrations (10YR 5/6); few very fine masses of gypsum; very slightly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Cy4—42 to 65 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; massive; very hard, very firm, sticky and slightly plastic; few very fine masses of gypsum; very slightly effervescent; moderately alkaline (pH 8.2).

Range in Characteristics

Particle size control section: 18 to 35 percent clay
Calcium carbonate equivalent: 0 to 1 percent in the surface and 0 to 5 percent in the substratum
Gypsum: 0 to 5 percent
Salinity: 0 to 4 mmhos/cm (very slightly saline)
Sodicity: 0 to 5 SAR (slightly sodic)
Rock fragments: 0 to 5 percent gravel
Reaction: slightly alkaline to strongly alkaline

A horizon:
Hue: 2.5Y
Value: 4 to 6 dry; 4 to 5 moist
Chroma: 2 to 3 dry and moist
Texture: fine sandy loam, loam, or silt loam

Bw, C, and Cy horizons:
Hue: 2.5Y
Value: 4 to 6 dry; 4 to 5 moist
Chroma: 2 to 4 dry and moist
Texture: fine sandy loam, sandy clay loam, silty clay loam, loam, silt loam, or clay loam

Beebe Series

Taxonomic class: Sandy, mixed, mesic Typic Torrifluvents
Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Geomorphic position: Flood plains and alluvial fans

Parent material: Stream and fan alluvium derived from sandstone and shale
Slope range: 0 to 5 percent
Elevation: 6,100 to 6,300 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 8 to 10 inches
Frost-free period: 100 to 135 days

Typical Pedon

Beebe silt loam, in an area of mapping unit 3, Beebe silt loam, 0 to 1 percent slopes; San Juan County, New Mexico; Pueblo Bonito Quadrangle; 1,300 feet west and 1,850 feet south of the northeast corner of sec. 27, T. 21 N., R. 10 W.; UTM: 13S 02-40-373, 39-90-540.

AC—0 to 5 inches; light olive brown (2.5Y 5/3) silt loam, olive brown (2.5Y 4/3) moist; weak thin platy structure; slightly hard, friable, nonsticky and nonplastic; many very fine roots; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.
C1—5 to 12 inches; light yellowish brown (2.5Y 6/3) stratified fine sandy loam, light olive brown (2.5Y 5/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; thin strata of silt and very fine sand; common very fine roots; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.
C2—12 to 15 inches; light yellowish brown (2.5Y 6/3) stratified loam, light olive brown (2.5Y 5/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; thin strata of silt and very fine sand; common very fine roots; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.
C3—15 to 20 inches; light yellowish brown (2.5Y 6/4) fine sand, light olive brown (2.5Y 5/4) moist; single grain; loose, loose, nonsticky and nonplastic; few very fine roots; slightly alkaline (pH 7.8); abrupt smooth boundary.
C4—20 to 30 inches; light yellowish brown (2.5Y 6/4) stratified fine sand, light olive brown (2.5Y 5/4) moist; single grain; loose, loose, nonsticky and nonplastic; few very fine roots; thin strata of silt and very fine sand; slightly alkaline (pH 7.8); abrupt smooth boundary.
C5—30 to 70 inches; light yellowish brown (2.5Y 6/4) fine sand, light olive brown (2.5Y 5/4) moist; single grain; loose, loose, nonsticky and nonplastic; few very fine roots; slightly alkaline (pH 7.8); abrupt smooth boundary.

Range in Characteristics:

Particle size control section: 0 to 10 percent clay
Calcium carbonate equivalent: 0 to 5 percent
Gypsum: 0 to 1 percent
Salinity: EC of 0 to 2 mmhos/cm (non saline)
Sodicity: SAR of 0 to 2 (slightly sodic)
Reaction: Slightly alkaline or moderately alkaline

AC horizon:
Hue: 10YR or 2.5Y
Value: 5 to 6 dry; 4 to 5 moist
Chroma: 3 to 4 dry and moist
Texture: loamy fine sand, fine sandy loam, loam or silt loam

C horizon:
Hue: 10YR or 2.5Y
Value: 6 to 7 dry; 4 to 5 moist
Chroma: 3 to 4 dry; 3 to 6 moist
Texture: sand, fine sand, loamy fine sand, fine sandy loam, loam or silt loam
Rock fragments: 0 to 5 percent gravel

Benally Series

Taxonomic class: Fine-loamy, mixed, superactive, mesic Typic Natrargids
Depth class: Deep and very deep
Drainage class: Well
Permeability: Slow
Geomorphic position: Erosional terraces and stream terraces
Parent material: Stream alluvium derived from sandstone and shale
Slope range: 1 to 5 percent
Elevation: 6,000 to 6,200 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 8 to 10 inches
Frost-free period: 100 to 135 days

Typical Pedon

Benally loamy fine sand, in an area of mapping unit 110, Benally-Fruitland association, 1 to 5 percent slopes; San Juan County, New Mexico; Kin Klizhin Ruins Quadrangle; 2,050 feet west and 2,900 feet north of the southeast corner of sec. 30, T. 21 N., R. 11 W.; UTM: 12S 07-66-367, 39-90-680.

A—0 to 1 inches; pale yellow (2.5Y 7/4) loamy fine sand, light olive brown (2.5Y 5/3) moist; massive; loose, friable, nonsticky and nonplastic; few very fine and fine roots; very slightly effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.
Btn1—1 to 4 inches; light yellowish brown (2.5Y 6/4) fine sandy loam, light olive brown (2.5Y 5/3) moist; moderate medium and coarse prismatic structure; very hard, friable, nonsticky and nonplastic; few

very fine and fine roots; few faint clay films on ped faces; slightly effervescent; very strongly alkaline (pH 9.6); abrupt smooth boundary.
Btn2—4 to 7 inches; light yellowish brown (2.5Y 6/4) fine sandy loam, light olive brown (2.5Y 5/3) moist; moderate medium and coarse subangular blocky structure; very hard, extremely firm, nonsticky and nonplastic; few very fine and fine roots; few faint clay films on ped faces; slightly effervescent; very strongly alkaline (pH 9.6); abrupt smooth boundary.
Btny1—7 to 13 inches; light yellowish brown (2.5Y 6/4) fine sandy loam, light olive brown (2.5Y 5/3) moist; weak medium and coarse subangular blocky structure; very hard, firm, sticky and plastic; few very fine and fine roots; 5 percent gravel; discontinuous gravel lines 1/2 inch thick; common distinct clay films on ped faces; few fine masses of gypsum; slightly effervescent; very strongly alkaline (pH 9.6); abrupt smooth boundary.
Btny2—13 to 29 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/3) moist; weak fine, medium, and coarse subangular blocky structure; very hard, firm, sticky and plastic; few very fine and fine roots; common distinct clay films on ped faces; many fine masses of gypsum; slightly effervescent; strongly alkaline (pH 8.6); abrupt smooth boundary.
BC1—29 to 40 inches; light yellowish brown (2.5Y 6/4) sandy clay loam, light olive brown (2.5Y 5/3) moist; massive; very hard, extremely firm, sticky and plastic; slightly effervescent; very strongly alkaline (pH 9.6); abrupt smooth boundary.
BC2—40 to 50 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; very hard, extremely firm, sticky and plastic; slightly effervescent; strongly alkaline (pH 8.8).
Cr—50 inches; shale.

Range in Characteristics

Particle-size control section: 18 to 35 percent clay
Depth to paralithic contact: 40 to more than 60 inches to weathered sandstone and shale
Calcium carbonate equivalent: 1 to 10 percent
Gypsum: 0 to 5 percent
Salinity: 0 to 4 mmhos/cm (very slightly saline)
Sodicity: 0 to 30 SAR (strongly sodic)

A horizon:
Hue: 2.5Y
Value: 5 or 7 dry; 4 or 5 moist
Chroma: 3 to 6 dry and moist
Texture: sandy clay loam or loamy fine sand
Rock fragments: 0 to 10 percent sandstone gravel
Reaction: moderately alkaline to strongly alkaline

Btny and Btn horizon:
Hue: 2.5Y
Value: 3 or 5 moist
Chroma: 3 or 4 dry and moist
Texture: fine sandy loam or clay loam
Rock fragments: 0 to 10 percent sandstone gravel
Reaction: strongly to very strongly alkaline

BC and C horizons:
Hue: 2.5Y
Value: 5 to7 dry; 4 to 6 moist
Chroma: 2 to 4 dry and moist
Texture: clay loam or sandy clay loam
Reaction: strongly alkaline to very strongly alkaline

Bond Series

Taxonomic class: Loamy, mixed, superactive, mesic Lithic Ustic Haplargids
Depth class: Very shallow and shallow
Drainage class: Well
Permeability: Moderate
Geomorphic position: Summits on mesas
Parent material: Eolian material and slope alluvium derived from sandstone
Slope range: 1 to 8 percent
Elevation: 6,700 to 6,900 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 10 to 13 inches
Frost-free period: 100 to 135 days

Typical Pedon

Bond fine sandy loam, in an area of mapping unit 220, Hagerwest-Bond fine sandy loams. 1 to 8 percent slopes; San Juan County, New Mexico; Pueblo Bonito Quadrangle; 3,100 feet west and 2,200 feet north of the southeast corner of sec. 34, T. 21 N., R. 10 W.; UTM: 13S 02-39-829, 39-88-452.

A—0 to 3 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; single grain; loose, loose, nonsticky and nonplastic; common very fine roots; 3 percent gravel; strongly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.
Btk—3 to 10 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; weak medium and coarse subangular blocky structure; soft, very friable, nonsticky and nonplastic; few very fine roots; few faint clay films on faces of peds; 1 percent sandstone gravel; few very fine masses of calcium carbonate; moderately alkaline (pH 8.0); abrupt smooth boundary.
Bk—10 to 15 inches; light yellowish brown (10YR 6/4)

fine sandy loam, yellowish brown (10YR 5/4) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; few very fine roots; few very fine masses of calcium carbonate; moderately alkaline (pH 8.0); abrupt smooth boundary.
R—15 inches; hard sandstone.

Range in Characteristics

Particle-size control section: 10 to 30 percent clay
Depth to a lithic contact: 10 to 20 inches to sandstone
Gypsum: None
Salinity: 0 to 2 mmhos/cm (nonsaline)
Sodicity: 0 SAR (nonsodic)
Reaction: slightly alkaline to moderately alkaline

A horizon:
Hue: 7.5YR or 10YR
Value: 5 to 6 dry; 4 to 5 moist
Chroma: 2 to 4 dry and moist
Rock fragments: 0 to 5 percent sandstone gravel

Bt, Btk, and Bk horizons:
Hue: 7.5YR or 10YR
Value: 5 to 6 dry; 4 to 5 moist
Chroma: 4 to 6 dry and moist
Calcium carbonate equivalent: 1 to 5 percent in the Btk and Bk horizons
Texture: fine sandy loam, sandy loam, or sandy clay loam
Rock fragments: 0 to 10 percent total; 0 to 10 percent gravel; 0 to 10 percent cobbles. All fragments are sandstone

Chacoan Series

Taxonomic class: Coarse-loamy, mixed, superactive, mesic Typic Haplargids
Depth class: Moderately deep
Drainage class: Somewhat excessive
Permeability: Moderately rapid
Geomorphic position: Dipslopes on cuestas and summits on mesas
Parent material: Eolian material and slope alluvium derived from sandstone
Slope range: 1 to 8 percent
Elevation: 6,100 to 6,500 feet
Mean annual air temperature: 48 to 52 degrees F.
Mean annual precipitation: 7 to 10 inches
Frost-free period: 100 to 135 days

Typical Pedon

Chacoan loamy fine sand, in an area of mapping unit 6, Chacoan-Shiprock loamy fine sands, 1 to 8 percent slopes; San Juan County, New Mexico; Pueblo Bonito Quadrangle; 1,900 feet west and 2,300 feet souh of the northeast corner of sec. 16, T. 21 N., R. 10 W.; UTM: 13S 02-38-831, 39-93-661.

A—0 to 2 inches; yellowish brown (10YR 5/4) loamy fine sand, dark yellowish brown (10YR 4/4) moist; single grain; loose, loose, nonsticky and nonplastic; few very fine roots; slightly alkaline (pH 7.6); abrupt smooth boundary.
Bt1—2 to 7 inches; yellowish brown (10YR 5/6) fine sandy loam, dark yellowish brown (10YR 4/6) moist; moderate medium and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; few very fine irregular pores; few faint clay films on faces of peds and bridging sand grains; 1 percent sandstone gravel; slightly alkaline (pH 7.6); abrupt smooth boundary.
Bt2—7 to 12 inches; yellowish brown (10YR 5/6) fine sandy loam, dark yellowish brown (10YR 4/6) moist; weak coarse prismatic structure; hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine irregular pores; few distinct clay films on faces of peds and bridging sand grains; 1 percent sandstone gravel; slightly alkaline (pH 7.6); abrupt smooth boundary.
Bt3—12 to 19 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; weak very fine and fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine irregular pores; clay bridging of sand grains; 1 percent sandstone gravel; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.
Bk—19 to 24 inches; yellowish brown (10YR 5/6) fine sandy loam, dark yellowish brown (10YR 4/6) moist; massive; very hard, friable, slightly sticky and slightly plastic; few very fine roots; 2 percent sandstone gravel; common very fine and fine masses of calcium carbonate; violently effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.
Cr—24 to 32 inches; soft weathered sandstone.
R—32 inches; hard sandstone bedrock.

Range in Characteristics

Particle-size control section: 10 to 18 percent clay
Depth to bedrock: 20 to 40 inches to hard sandstone Some pedons do not have a paralithic contact above the hard lithic contact.
Rock fragments: 0 to 5 percent gravel throughout. All fragments are sandstone.
Gypsum: None
Salinity: 0 to 2 mmhos/cm (nonsaline)
Sodicity: 0 SAR (nonsodic)

Reaction: slightly alkaline to moderately alkaline

A horizon
Hue: 10YR
Value: 5 or 6 dry, 4 or 5 moist
Chroma: 3 or 4 dry and moist
Texture: loamy fine sand or fine sandy loam

Bt horizon
Hue: 10YR
Value: 5 or 6 dry, 4 to 5 moist
Chroma: 4 or 6 dry and moist
Texture: fine sandy loam

Btk and Bk horizons
Hue: 10YR
Value: 5 to 6 dry, 4 to 5 moist
Chroma: 4 or 6 dry and moist
Calcium carbonate equivalence: 0 to 5 percent.
Texture: loamy fine sand, fine sandy loam, or sandy clay loam

Doak Series

Taxonomic class: Fine-loamy, mixed, active, mesic Typic Haplargids
Depth class: Very deep
Drainage class: Well
Permeability: Moderately slow
Geomorphic position: Fan remnants on valley sides
Parent material: Fan alluvium derived from sandstone and shale
Slope range: 1 to 5 percent
Elevation: 6,100 to 6,300 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 8 to 10 inches
Frost-free period: 100 to 135 days

Typical Pedon

Doak loam, in an area of mapping unit 9, Doak loam, 1 to 5 percent slopes; San Juan County, New Mexico; Pueblo Bonito Quadrangle; 650 feet east and 1,000 feet north of the southwest corner of sec. 29, T. 21 N., R. 10 W.; UTM: 13S 02-36-060, 39-89-723.

A—0 to 2 inches; light yellowish brown (2.5Y 6/3) loam, olive brown (2.5Y 4/3) moist; weak very fine granular structure; loose, friable, slightly sticky and slightly plastic; few very fine and fine roots; slightly alkaline (pH 7.8); abrupt smooth boundary.

Bt1—2 to 8 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; moderate medium and coarse subangular blocky structure; very hard, friable, sticky and plastic; few very fine and fine roots; few distinct clay films on faces of peds; 1 percent gravel; slightly alkaline (pH 7.8); abrupt smooth boundary.

Bt2—8 to 24 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; strong, coarse prismatic parting to medium and coarse subangular blocky structure; very hard, very friable, sticky and plastic; few very fine and fine roots; common distinct clay films on faces of peds; cicada casts; slightly alkaline (pH 7.8); abrupt smooth boundary.

Bt3—24 to 31 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; weak very fine angular blocky structure; very hard, friable, sticky and plastic; few very fine roots; few very fine irregular pores; few faint clay films on faces of peds; 1 percent gravel; very slightly effervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.

Bk1—31 to 44 inches; pale yellow (2.5Y 7/3) clay loam, light olive brown (2.5Y 5/3) moist; weak coarse subangular blocky structure; very hard, firm, sticky and plastic; few very fine roots; common very fine masses and filaments of calcium carbonate; very slightly effervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.

Bk2—44 to 54 inches; pale yellow (2.5Y 7/3) clay loam, light olive brown (2.5Y 5/4) moist; weak very fine and fine subangular blocky structure; very hard, firm, sticky and plastic; few very fine roots; few very fine masses of calcium carbonate; very slightly effervescent; slightly alkaline (pH 7.8); abrupt wavy boundary.

BCk1—54 to 60 inches; pale yellow (2.5Y 7/3) clay loam, light olive brown (2.5Y 5/4) moist; massive; very hard, firm, sticky and plastic; few very fine roots; few very fine masses of calcium carbonate; very slightly effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

BCk2—60 to 70 inches; pale yellow (2.5Y 7/3) clay loam, light olive brown (2.5Y 5/4) moist; massive; very hard, firm, sticky and plastic; common very fine masses of calcium carbonate; slightly effervescent; moderately alkaline (pH 8.0).

Range in Characteristics

Particle-size control section: 18 to 35 percent clay
Calcium carbonate equivalent: 0 to 5 percent
Gypsum: 0 to 1 percent
Salinity: 0 to 2 mmhos/cm (nonsaline)
Sodicity: 0 to 2 SAR (nonsodic)
Rock fragments: 0 to 10 percent gravel throughout. All fragments are sandstone.
Reaction: neutral to moderately alkaline in the

surface and slightly to strongly alkaline in the subsoil

A horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6 dry; 3 to 5 moist
Chroma: 2 to 4 dry and moist
Textures: fine sandy loam, loam, or silt loam

Bt horizon:
Hue: 10YR to 2.5Y
Value: 5 to 6 dry; 4 to 6 moist
Chroma: 3 to 6 dry and moist
Textures: clay loam or sandy clay loam

Bk and BCk horizons:
Hue: 10YR to 2.5Y
Value: 5 to 8 dry; 4 to 6 moist
Chroma: 3 to 6 dry and moist
Textures: loam, sandy clay loam, or clay loam
Some pedons have C horizons that are stratified below 40 inches.

Escawetter Series

Taxonomic class: Sandy, mixed, mesic Oxyaquic Torrifluvents
Depth class: Very deep
Drainage class: Moderately well
Permeability: Moderately rapid
Geomorphic position: Flood plains
Parent material: Stream alluvium derived from sandstone and shale
Slope range: 0 to 1 percent
Elevation: 6,000 to 6,100 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 8 to 10 inches
Frost-free period: 100 to 135 days

Typical Pedon

Escawetter fine sand, in an area of mapping unit 13, Escawetter fine sand, 0 to 1 percent slopes; San Juan County, New Mexico; Kin Klizhin Ruins Quadrangle; 200 feet east and 2,300 feet south of the northwest corner of sec. 8, T. 21 N., R. 11 W.; UTM: 12S 07-66-588, 39-95-875.

AC—0 to 6 inches; light olive brown (2.5Y 5/4) and light yellowish brown (2.5Y 6/3) stratified fine sand, olive brown (2.5Y 4/4) and light olive brown (2.5Y 5/3) moist; moderate very thin platy structure; soft, very friable, nonsticky and nonplastic; few very fine roots; thin strata of silt and very fine sand; slightly effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.
C1—6 to 19 inches; light gray (2.5Y 7/2) coarse sand, light brown gray (2.5Y 6/2) moist; single grain; loose, loose, nonsticky and nonplastic; few very fine roots; slightly alkaline (pH 7.6); abrupt smooth boundary.
C2—19 to 38 inches; pale yellow (2.5Y 7/3) coarse sand, light yellowish brown (2.5Y 6/3) moist; single grain; loose, loose, nonsticky and nonplastic; few very fine roots; 1 percent gravel; slightly alkaline (pH 7.6); abrupt smooth boundary.
C3—38 to 65 inches; light yellowish brown (2.5Y 6/3) coarse sand, light olive brown (2.5Y 5/3) moist; single grain; loose, loose, nonsticky and nonplastic; water table at 48 inches; few very fine roots; slightly alkaline (pH 7.6).

Range in Characteristics

Particle-size control section: 2 to 10 percent clay
Depth to seasonal water table: 4 to 5 feet
Calcium carbonate equivalent: 0 to 2 percent
Gypsum: 0 to 1 percent
Salinity: 0 to 4 mmhos/cm (very slightly saline)
Sodicity: 0 to 2 SAR (slightly sodic)
Rock fragment content: 0 to 5 percent sandstone pebbles
Reaction: slightly to moderately alkaline

AC horizon:
Hue: 10YR or 2.5Y
Value: 5 to 7 dry, 4 to 6 moist
Chroma: 2 to 4 dry and moist
Texture: loamy fine sand, sand, fine sand, or silt loam

C horizons:
Hue: 10YR or 2.5Y.
Value: 5 to 7 dry, 4 to 6 moist.
Chroma: 2 to 4 dry and moist
Texture: most horizons are dominantly coarse sand with laminations and thin strata of very fine sand, loamy very fine sand, or silt loam; individual horizons are laterally discontinuous and cross-laminated.

Fajada Series

Taxonomic class: Fine-loamy, mixed, superactive, mesic Typic Natrargids
Depth class: Moderately deep
Drainage class: Well
Permeability: Moderately slow
Geomorphic position: Erosional terraces
Parent material: Alluvium over residuum derived from sandstone and shale
Slope range: 1 to 5 percent
Elevation: 6,000 to 6,200 feet

Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 8 to 10 inches
Frost-free period: 100 to 135 days

Typical Pedon

Fajada fine sandy loam, in an area of mapping unit 116, Fajada-Huerfano-Benally complex, 1 to 5 percent slopes; San Juan County, New Mexico; Kin Klizhin Ruins Quadrangle; 1,000 feet west and 2,000 feet north of the southeast corner of sec. 30, T. 21 N., R. 11 W.; UTM: 12S 07-66-645, 39-90-399.

A—0 to 3 inches; light yellowish brown (2.5Y 6/4) fine sandy loam, light olive brown (2.5Y 5/4) moist; weak very fine granular structure; loose, very friable, nonsticky and nonplastic; common very fine roots; 2 percent gravel; strongly effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.

Btn—3 to 9 inches; light yellowish brown (2.5Y 6/4) fine sandy loam, light olive brown (2.5Y 5/4) moist; moderate fine and medium columnar structure; very hard, friable, slightly sticky and slightly plastic; few very fine roots; few faint clay films on ped faces; 2 percent gravel; strongly effervescent; strongly alkaline (pH 9.0); abrupt smooth boundary.

Btkn—9 to 12 inches; light yellowish brown (2.5Y 6/4) sandy clay loam, light olive brown (2.5Y 5/4) moist; weak fine and medium subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; few very fine roots; few distinct clay films on ped faces; 2 percent gravel; common fine masses of calcium carbonate; violently effervescent; very strongly alkaline (pH 9.6); abrupt smooth boundary.

Bn1—12 to 17 inches; light yellowish brown (2.5Y 6/4) fine sandy loam, light olive brown (2.5Y 5/4) moist; weak very fine subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; few very fine roots; 10 percent gravel; strongly effervescent; very strongly alkaline (pH 9.6); abrupt smooth boundary.

Bn2—17 to 28 inches; light yellowish brown (2.5Y 6/4) fine sandy loam, grayish brown (2.5Y 5/2) moist; weak medium and coarse subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; few very fine roots; 2 percent gravel; strongly effervescent; very strongly alkaline (pH 9.6); abrupt smooth boundary.

C—28 to 34 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; massive; very hard, friable, slightly sticky and slightly plastic; few very fine roots; strongly effervescent; strongly alkaline (pH 8.6); clear wavy boundary.

Cr—34 inches; shale and coal seams.

Range in Characteristics

Particle size control section: 18 to 25 percent clay
Depth to paralithic contact: 20 to 40 inches to interbedded soft sandstone and shale
Gypsum: 0 to 2 percent

A horizon:
- *Hue:* 10YR or 2.5Y
- *Value:* 3 to 6 dry, 3 to 5 moist
- *Chroma:* 4 to 6 dry and moist
- *Texture:* fine sandy loam or loam
- *Rock fragments:* 5 to 20 percent siderite and sandstone gravel
- *Reaction:* moderately or strongly alkaline

B and C horizons:
- *Hue:* 10YR or 2.5Y
- *Value:* 3 to 6 dry, 3 to 5 moist
- *Chroma:* 4 to 6 dry and moist
- *Calcium carbonate equivalent:* 1 to 10 percent
- *Salinity:* EC of 1 to 4 mmhos/cm (very slightly saline)
- *Sodicity:* SAR of 13 to 30 (moderately to strongly sodic)
- *Texture:* sandy clay loam
- *Rock fragments:* 0 to 5 percent siderite and sandstone pebbles
- *Reaction:* strongly or very strongly alkaline

Farb Series

Taxonomic class: Loamy, mixed, superactive, calcareous, mesic Lithic Torriorthents
Depth class: Very shallow and shallow
Drainage class: Excessive
Permeability: Moderately rapid
Geomorphic position: Structural benches on escarpments
Parent material: Slope alluvium over residuum derived from sandstone
Slope range: 5 to 20 percent
Elevation: 6,000 to 6,600 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 8 to 10 inches
Frost-free period: 100 to 135 days

Typical Pedon

Farb loamy fine sand, in an area of mapping unit 5, Farb-Rock outcrop complex, 5 to 20 percent slopes; San Juan County, New Mexico; Sargent Ranch Quadrangle; 600 feet east and 1,350 feet south of the northwest corner of sec. 23, T. 21 N., R. 10 W.; UTM: 13S 02-41-074, 39-92-461.

A—0 to 1 inches; light yellowish brown (2.5Y 6/4) loamy fine sand, light olive brown (2.5Y 5/4) moist; massive; loose, loose, nonsticky and nonplastic; many very fine roots; 3 percent gravel; slightly effervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.

Bw—1 to 5 inches; light yellowish brown (2.5Y 6/4) loamy fine sand, light olive brown (2.5Y 5/4) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; 4 percent gravel; slightly effervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.

C1—5 to 11 inches; light yellowish brown (2.5Y 6/4) loamy fine sand, light olive brown (2.5Y 5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; 4 percent gravel and 10 percent channers; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

C2—11 to 15 inches; light yellowish brown (2.5Y 6/4) fine sandy loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; 1 percent gravel; slightly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.

R—15 inches; hard sandstone.

Range in Characteristics

Particle size control section: 5 to 10 percent clay
Depth to a lithic contact: 5 to 20 inches to sandstone
Calcium carbonate: 0 to 5 percent
Gypsum: None
Salinity: 0 to 1 mmhos/cm (nonsaline)
Sodicity: 0 SAR (nonsodic)
Reaction: slightly alkaline to moderately alkaline

A horizon:
Hue: 10YR or 2.5Y
Value: 5 or 6 dry; 4 to 5 moist
Chroma: 3 to 4 dry and moist
Rock fragments: 0 to 25 percent sandstone gravel; 0 to 5 percent cobbles

Bw and C horizon:
Hue: 10YR or 2.5YR
Value: 5 or 6 dry; 4 to 5 moist
Chroma: 3 to 4 dry and moist
Textures: loamy fine sand or fine sandy loam
Rock fragments: 0 to 15 percent sandstone gravel and 0 to 10 percent channers

Some pedons have a very thin Bw horizon.

Fruitland Series

Taxonomic class: Coarse-loamy, mixed, superactive, calcareous, mesic Typic Torriorthents
Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Geomorphic position: Stream terraces on valley floors
Parent material: Eolian material and stream alluvium derived from sandstone
Slope range: 1 to 5 percent
Elevation: 6,000 to 6,200 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 8 to 10 inches
Frost-free period: 100 to 135 days

Typical Pedon

Fruitland loamy fine sand, in an area of mapping unit 110, Benally-Fruitland association, 1 to 5 percent slopes; San Juan County, New Mexico; Kin Klizhin Ruins Quadrangle; 2,350 feet west and 2,150 feet south of the northeast corner of sec. 30, T. 21 N., R. 11 W.; UTM: 12S 07-66-293, 39-90-700.

A—0 to 4 inches; light olive brown (2.5Y 5/4) loamy fine sand, light olive brown (2.5Y 5/4) moist; single grain; loose, loose, nonsticky and nonplastic; common very fine roots; slightly alkaline (pH 7.8); abrupt smooth boundary.

C1—4 to 20 inches; light yellowish brown (2.5Y 6/4) loamy fine sand, light olive brown (2.5Y 5/4) moist; single grain; loose, loose, nonsticky and nonplastic; many very fine and fine roots; moderately alkaline (pH 8.0); clear smooth boundary.

C2—20 to 30 inches; light yellowish brown (2.5Y 6/4) loamy fine sand, light olive brown (2.5Y 5/4) moist; single grain; loose, loose, nonsticky and nonplastic; common very fine roots; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Ck1—30 to 40 inches; light yellowish brown (2.5Y 6/4) gravelly sandy clay loam, light olive brown (2.5Y 5/4) moist; massive; hard, firm, slightly sticky and slightly plastic; few very fine roots; 20 percent gravel; few very fine and fine masses of calcium carbonate; slightly effervescent; strongly alkaline (pH 8.6); abrupt smooth boundary.

Ck2—40 to 49 inches; light yellowish brown (2.5Y 6/4) sandy clay loam, light olive brown (2.5Y 5/4) moist; massive; hard, firm, slightly sticky and nonplastic; few very fine roots; few very fine

masses of calcium carbonate; strongly effervescent; strongly alkaline (pH 8.6); abrupt smooth boundary.
Ck3—49 to 58 inches; light yellowish brown (2.5Y 6/3) fine sandy loam, light olive brown (2.5Y 5/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; few very fine masses of calcium carbonate; strongly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.
Ck4—58 to 70 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; common distinct yellowish brown mottles (10YR 5/6); massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; few very fine masses of calcium carbonate; strongly effervescent; moderately alkaline (pH 8.2).

Range in Characteristics

Particle-size control section: 5 to 18 percent clay
Calcium carbonate equivalent: 1 to 10 percent
Gypsum: 0 to 1 percent
Salinity: 0 to 2 mmhos/cm (nonsaline)
Sodicity: 0 to 5 SAR (slightly sodic)

A horizon:
Hue: 10YR or 2.5Y
Value: 5 or 6 dry; 4 or 5 moist
Chroma: 3 to 6, dry and moist
Texture: loamy fine sand
Reaction: slightly to moderately alkaline

C horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, dry and moist
Chroma: 3 to 6, dry and moist
Texture: loamy sand, loamy fine sand, or fine sandy loam
Reaction: slightly to moderately alkaline

Ck horizon:
Hue: 10YR or 2.5Y
Value: 5 or 6, dry and moist
Chroma: 2 to 6, dry and moist
Calcium carbonate equivalent: 1 to 10 percent
Texture: fine sandy loam or sandy clay loam
Rock fragments: 0 to 20 percent sandstone gravel
Reaction: moderately to strongly alkaline

Hagerwest Series

Taxonomic class: Fine-loamy, mixed, superactive, mesic Ustic Haplargids
Depth class: Moderately deep
Drainage class: Well drained
Permeability: Moderate
Geomorphic position: Summits on mesas
Parent material: Eolian material and slope alluvium derived from sandstone and shale
Slope range: 1 to 8 percent
Elevation: 6,700 to 6,900 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 10 to 13 inches
Frost-free period: 100 to 135 days

Typical Pedon

Hagerwest fine sandy loam, in an area of mapping unit 220, Hagerwest-Bond fine sandy loams, 1 to 8 percent slopes; McKinley County, New Mexico; Seven Lakes NE Quadrangle; 2,100 feet west and 2,000 feet north of the southeast corner of sec. 1, T. 20 N., R. 10 W.; UTM: 13S 02-43-231, 39-86-340.

A—0 to 2 inches; yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; few very fine roots; slightly alkaline (pH 7.8); abrupt smooth boundary.
Bt1—2 to 7 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak medium and coarse subangular blocky structure; hard, friable, sticky and slightly plastic; few distinct clay films on faces of peds and bridging sand grains; few very fine roots; slightly alkaline (pH 7.8); abrupt smooth boundary.
Bt2—7 to 13 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few distinct clay films on faces of peds and bridging sand grains; few very fine roots; slightly alkaline (pH 7.8); abrupt smooth boundary.
BC—13 to 21 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak fine and medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; 8 percent sandstone gravel; few very fine roots; slightly alkaline (pH 7.8); abrupt smooth boundary.
R—21 inches; hard sandstone bedrock

Range in Characteristics

Particle-size control section: 18 to 35 percent clay
Rock fragments: 0 to 15 percent sandstone gravel
Depth to a lithic contact: 20 to 40 inches to sandstone bedrock
Calcium carbonate equivalent: 0 to 2 percent
Gypsum: None
Salinity: 0 to 2 mmhos/cm (nonsaline)

Sodicity: 0 SAR (nonsodic)

A horizon:
Hue: 7.5YR or 10 YR
Value: 5 to 6 dry; 3 to 5 moist
Chroma: 4 dry and moist
Reaction: neutral to slightly alkaline

Bt horizon:
Hue: 7.5YR or 10YR
Value: 4 to 5 dry; 3 to 5 moist
Chroma: 4 dry and moist
Texture: sandy clay loam or clay loam
Reaction: neutral to slightly alkaline

BC horizon:
Hue: 7.5YR or 10YR
Value: 5 to 7 dry; 4 to 6 moist
Chroma: 4 dry and moist
Texture: sandy loam, sandy clay loam, or clay loam
Reaction: slightly to moderately alkaline

Hospah Series

Taxonomic class: Clayey, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents
Depth class: Very shallow and shallow
Drainage class: Well drained
Permeability: Slow
Geomorphic position: Escarpments on cuestas and mesas
Parent material: Colluvium over residuum derived from shale and sandstone
Slope range: 2 to 35 percent
Elevation: 6,400 to 6,800 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 10 to 13 inches
Frost-free period: 100 to 135 days

Typical Pedon

Hospah clay loam, in an area of mapping unit 250, Hospah-Skyvillage-Rock outcrop complex, 2 to 35 percent slopes; San Juan County, New Mexico; Pueblo Bonito Quadrangle; 1,700 feet east and 2,100 feet north of the southwest corner of sec. 27, T. 21 N., R. 10 W.; UTM: 13S 02-39-660, 39-89-969.

A—0 to 3 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; moderate very fine granular structure; soft, friable, very sticky and very plastic; 10 percent gravel and 2 percent cobbles; very slightly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.
C—3 to 15 inches; light yellowish brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist; massive; very hard, very firm, very sticky and very plastic; 10 percent shale fragments; very slightly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.
Cr—15 inches; shale.

Range in Characteristics

Particle-size control section: 40 to 60 percent clay
Depth to paralithic contact: 5 to 20 inches
Calcium carbonate equivalent: 1 to 5 percent
Gypsum: 1 to 5 percent
Salinity: EC of 0 to 4 mmhos/cm (very slightly saline)
Sodicity: 1 to 5 in the surface to 5 to 10 in the substratum (slightly to moderately sodic)
Reaction: moderately alkaline

A horizon:
Hue: 2.5Y or 10YR
Value: 4 to 6 dry, 3 to 5 moist
Chroma: 2 to 4 dry and moist
Rock fragments: 10 to 50 percent total; 5 to 30 percent gravel, 5 to 30 percent cobbles, and 15 to 50 percent channers. All fragments are sandstone.

C horizons:
Hue: 2.5Y or 10YR
Value: 4 to 5 dry, 3 to 4 moist
Chroma: 2 to 4 dry and moist

Huerfano Series

Taxonomic class: Loamy, mixed, superactive, mesic, shallow Typic Natrargids
Depth class: Shallow
Drainage class: Well drained
Permeability: Slow
Geomorphic position: Erosional terraces
Parent material: Alluvium over residuum derived from sandstone and shale
Slope range: 1 to 5 percent
Elevation: 6,000 to 6,200 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 8 to 10 inches

Frost-free period: 100 to 135 days

Typical Pedon

Huerfano clay loam, in an area of mapping unit 116, Fajada-Huerfano-Benally complex, 1 to 5 percent slopes; San Juan County, New Mexico; Kin Klizhin Ruins Quadrangle; 750 feet west and 2,200 feet north of the southeast corner of sec. 30, T. 21 N., R. 11 W.; UTM: 12S 07-66-669, 39-90-472.

Btn—0 to 4 inches; olive yellow (2.5Y 6/6) clay loam, light olive brown (2.5Y 5/6) moist; moderate very fine and fine columnar structure; very hard, very friable, sticky and plastic; common very fine roots; few faint clay films on ped faces; 14 percent gravel; very slightly effervescent; very strongly alkaline (pH 9.6); abrupt smooth boundary.
Cr—4 to 20 inches; shale.

Range in Characteristics

Particle-size control section: 18 to 35 percent clay
Depth to a paralithic contact: 4 to 20 inches to shale
Gypsum: 0 to 2 percent
Salinity: 0 to 4 mmhos/cm (very slightly saline)
Sodicity: 13 to 30 SAR (moderately to strongly sodic)

A horizon: (if present)
Hue: 10YR or 2.5Y
Value: 4 or 5 moist
Chroma: 3 or 4 moist
Calcium carbonate: 1 to 5 percent
Rock fragments: 5 to 20 percent sandstone and siderite gravel
Reaction: moderately or strongly alkaline

Btn horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6 dry and moist
Chroma: 2 to 4 dry and moist
Calcium carbonate: 1 to 10 percent
Texture: clay loam or sandy clay loam
Rock fragments: 0 to 15 percent sandstone and siderite gravel
Reaction: strongly to very strongly alkaline

Kimnoli Series

Taxonomic class: Loamy, mixed, active, mesic Lithic Haplargids
Depth class: Very shallow and shallow
Drainage class: Well drained
Permeability: Moderately rapid
Geomorphic position: Summits on mesas
Parent material: Eolian material and slope alluvium derived from sandstone
Slope range: 1 to 3 percent
Elevation: 6,100 to 6,700 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 8 to 10 inches
Frost-free period: 100 to 135 days

Typical Pedon

Kimnoli loamy fine sand, in an area of mapping unit 7, Chacoan-Kimnoli loamy fine sands, 1 to 3 percent slopes; San Juan County, New Mexico; Pueblo Bonito Quadrangle; 200 feet west and 1,300 feet north of the southeast corner of sec. 15, T. 21 N., R. 11 W.; UTM: 13S 02-31-201, 39-93-289.

A—0 to 3 inches; yellowish brown (10YR 5/6) loamy fine sand, yellowish brown (10YR 5/6) moist; weak very fine granular structure; soft, very friable, nonsticky and nonplastic; common very fine roots; 3 percent sandstone gravel; moderately alkaline (pH 8.2); abrupt smooth boundary.
Bt—3 to 10 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; weak very fine and fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; few very fine roots; 10 percent sandstone gravel; few faint clay films on faces of peds and bridging sand grains; moderately alkaline (pH 8.2); abrupt smooth boundary.
R—10 inches; hard sandstone bedrock.

Range in Characteristics

Particle-size control section: 10 to 30 percent clay
Depth to lithic contact: 10 to 20 inches to sandstone
Calcium carbonate equivalent: 0 to 5 percent
Gypsum: None
Salinity: 0 to 2 mmhos/cm (nonsaline)
Sodicity: 0 SAR (nonsodic)
Rock fragments: 0 to 10 percent total; 0 to 5 percent gravel; 0 to 5 percent cobbles. All fragments are sandstone.
Reaction: slightly or moderately alkaline

A horizon:
Hue: 10YR
Value: 4 to 6 dry; 3 to 4 moist
Chroma: 3 to 6 moist

Bt horizon:
Hue: 10YR
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 3 to 6 dry and moist
Texture: sandy loam or sandy clay loam

Notal Series

Taxonomic class: Fine, mixed, active, calcareous, mesic Typic Torriorthents
Depth class: Very deep
Drainage class: Well
Permeability: Very slow
Geomorphic position: Stream terraces
Parent material: Stream alluvium derived from shale
Slope range: 0 to 1 percent
Elevation: 6,000 to 6,300 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 8 to 10 inches
Frost-free period: 100 to 135 days

Typical Pedon

Notal clay loam in an area of mapping unit 2, Battlerock-Notal complex, 0 to 1 percent slopes; San Juan County, New Mexico; Pueblo Bonito Quadrangle; 1,600 feet west and 500 feet south of the northeast corner of sec. 29, T. 21 N., R. 10 W.; UTM: 13S 02-37-156, 39-90-920.

A—0 to 2 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; moderate very fine granular structure; loose, loose, sticky and plastic; many very fine and few fine roots; slightly alkaline (pH 7.8); abrupt smooth boundary.
Bw—2 to 7 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; moderate, very thin platy parting to moderate, very fine and fine subangular blocky structure; hard, very friable, sticky and plastic; many, very fine and few fine roots; very slightly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.
Bk—7 to 14 inches; light yellowish brown (2.5Y 6/3) clay, light olive brown (2.5Y 5/3) moist; weak, very fine and fine subangular blocky structure; very hard, firm, very sticky and very plastic; common very fine, fine and medium roots; few very fine masses and filaments of calcium carbonate; very slightly effervescent; strongly alkaline (pH 8.8); abrupt smooth boundary.
Bky—14 to 19 inches; light yellowish brown (2.5Y 6/3) clay, light olive brown (2.5Y 5/3) moist; weak very fine and fine angular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; few very fine masses of calcium carbonate; common very fine and fine masses of gypsum; very slightly effervescent; strongly alkaline (pH 8.6); abrupt smooth boundary.
BC1—19 to 26 inches; light yellowish brown (2.5Y 6/3) silty clay loam, light olive brown (2.5Y 5/3) moist; weak very thin platy structure; hard, firm, sticky and plastic; few very fine roots; very slightly effervescent; strongly alkaline (pH 8.6); abrupt smooth boundary.
BC2—26 to 70 inches; light yellowish brown (2.5Y 6/3) silty clay, light olive brown (2.5Y 5/3) moist; weak very fine subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; very slightly effervescent; moderately alkaline (pH 8.4).

Range in Characteristics

Particle-size control section: 35 to 55 percent clay
Calcium carbonate equivalent: 1 to 5 percent
Gypsum: 0 to 5 percent
Rock fragments: 0 to 5 percent gravel
Reaction: moderately to strongly alkaline

A horizon:
Hue: 2.5Y
Value: 5 or 6 dry, 4 to 5 moist
Chroma: 3 or 4 dry and moist
Salinity: EC of 0 to 4 mmhos/cm (slightly saline)
Sodicity: SAR of 5 to 10 (slightly sodic)
Texture: silt loam, clay loam, or silty clay loam

Bw and BC horizons:
Hue: 2.5Y
Value: 4 to 6 dry, 4 or 5 moist
Chroma: 3 or 4 dry and moist
Salinity: EC of 2 to 8 mmhos/cm (slightly saline)
Sodicity: SAR of 5 to 30 (moderately sodic)
Texture: silty clay loam, silty clay, or clay

Some pedons have diagnostic cambic horizons. This does not affect use or management.

Persayo Series

Taxonomic class: Loamy, mixed, active, calcareous, mesic, shallow Typic Torriorthents
Depth class: Very shallow and shallow
Drainage class: Well drained
Permeability: Moderately rapid
Geomorphic position: Escarpments on mesas and cuestas
Parent material: Slope alluvium over residuum derived from sandstone and shale
Slope range: 20 to 45 percent
Elevation: 6,200 to 6,600 feet
Mean annual air temperature: 48 to 50 degrees F.

Mean annual precipitation: 8 to 10 inches
Frost-free period: 100 to 135 days

Typical Pedon

Persayo gravelly fine sandy loam, in an area of mapping unit 16, Rock outcrop-Persayo complex, 20 to 70 percent slopes; San Juan County, New Mexico; Pueblo Bonito Quadrangle; 2,300 feet east and 100 feet north of the southwest corner of sec. 18, T. 21 N., R. 10 W.; UTM: 13S 02-35-057, 39-92-810.

A—0 to 2 inches; pale yellow (2.5Y 8/4) gravelly fine sandy loam, light olive brown (2.5Y 5/4) moist; weak very fine granular structure; loose, loose, nonsticky and nonplastic; common very fine roots; 10 percent gravel, 5 percent flagstones and 1 percent boulders; slightly effervescent; slightly alkaline (pH 7.6); abrupt smooth boundary.
C—2 to 9 inches; light pale yellow (2.5Y 8/4) and white (2.5Y 8/1) fine sandy loam, pale yellow (2.5Y 7/4) and light gray (2.5Y 7/1) moist; massive; loose, loose, nonsticky and nonplastic; many very fine roots; 10 percent gravel; slightly effervescent; slightly alkaline (pH 7.6); clear wavy boundary.
Cr—9 to 23 inches; weathered sandstone
R—23 inches; hard sandstone bedrock.

Range in Characteristics

Particle size control section: 10 to 25 percent clay
Calcium carbonate equivalent: 1 to 5 percent
Gypsum: 0 to 1 percent
Salinity: 0 to 2 mmhos/cm (nonsaline)
Sodicity: 0 to 2 SAR (slightly sodic)
Rock fragments: 0 to 35 percent total; 0 to 30 percent gravel, 0 to 5 percent flagstones, 0 to 5 percent cobbles, 0 to 5 percent stones, 0 to 1 percent boulders. All fragments are sandstone.
Reaction: slightly to moderately alkaline

A horizon:
Hue: 2.5Y
Value: 6 to 8 dry; 4 to 6 moist
Chroma: 3 to 4 dry and moist
Texture: fine sandy loam or sandy clay loam

C horizon:
Hue: 2.5Y
Value: 6 to 8 dry; 4 to 7 moist
Chroma: 4 to 6 dry and moist
Texture: fine sandy loam

Razito Series

Taxonomic class: Mixed, mesic Typic Torripsamments
Depth class: Very deep
Drainage class: Excessive
Permeability: Rapid
Geomorphic position: Dunes
Parent material: Eolian material derived from sandstone
Slope range: 3 to 45 percent
Elevation: 6,000 to 6,300 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 8 to 10 inches
Frost-free period: 100 to 135 days

Typical Pedon

Razito loamy fine sand, in an area of mapping unit 17, Razito loamy fine sand, 5 to 45 percent slopes; San Juan County, New Mexico; Pueblo Bonito Quadrangle; 1,200 feet east and 700 feet south of the northwest corner of sec. 19, T. 21 N., R. 10 W.; UTM: 13S 02-34-773, 39-92-597.

A—0 to 3 inches; brown (10YR 5/4) loamy fine sand, brown (10YR 5/4) moist; single grain; loose, loose, nonsticky and nonplastic; many very fine and fine roots; slightly alkaline (pH 7.6); abrupt smooth boundary.
C1—3 to 15 inches; yellowish brown (10YR 5/6) fine sand, yellowish brown (10YR 5/6) moist; single grain; slightly hard, very friable, nonsticky and nonplastic; many very fine and fine roots; 1 percent gravel; very slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary
C2—15 to 44 inches; yellowish brown (10YR 5/6) fine sand, yellowish brown (10YR 5/6) moist; single grain; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots; very slight effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.
C3—44 to 70 inches; yellowish brown (10YR 5/6) fine sand, yellowish brown (10YR 5/6) moist; single grain; loose, loose, nonsticky and nonplastic; common very fine and fine roots; slightly effervescent; moderately alkaline (pH 8.0).

Range in Characteristics

Particle-size control section: 2 to 8 percent clay
Calcium carbonate equivalent: 0 to 5 percent
Gypsum: None
Salinity: 0 to 2 mmhos/cm (nonsaline)
Sodicity: 0 to 2 SAR (slightly sodic)

A horizon:
Hue: 10YR or 2.5Y
Value: 5 to 6 dry; 4 to 5 moist
Chroma: 3 to 6 dry and moist
Texture: loamy fine sand, fine sand, or sand

Reaction: slightly alkaline

C horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6 dry; 4 to 5 moist
Chroma: 3 to 6 dry and moist
Texture: loamy sand, loamy fine sand, fine sand, or sand
Reaction: moderately alkaline

Shiprock Series

Taxonomic class: Coarse-loamy, mixed, superactive, mesic Typic Haplargids
Depth class: Very deep
Drainage class: Somewhat excessive
Permeability: Moderately rapid
Geomorphic position: Dipslopes on cuestas and fan remnants on valley sides
Parent material: Eolian material over slope or fan alluvium derived from sandstone
Slope range: 1 to 8 percent
Elevation: 6,000 to 6,600 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 8 to 10 inches
Frost-free period: 100 to 135 days

Typical Pedon

Shiprock loamy fine sand, in an area of mapping unit 6, Chacoan-Shiprock loamy fine sands, 1 to 8 percent slopes; San Juan County, New Mexico; Pueblo Bonito Quadrangle; 400 feet west and 800 feet south of the northeast corner of sec. 16, T. 21 N., R. 10 W.; UTM: 13S 02-39-089, 39-94-110.

A—0 to 2 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 4/3) moist; weak very fine granular structure; loose, loose, nonsticky and nonplastic; slightly alkaline (pH 7.4); abrupt smooth boundary.
Bt1—2 to 4 inches; dark yellowish brown (10YR 4/6) fine sandy loam, dark yellowish brown (10YR 4/4) moist; moderate fine and medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; few faint clay films on faces of peds and bridging sand grains; slightly alkaline (pH 7.4); abrupt smooth boundary.
Bt2—4 to 21 inches; yellowish brown (10YR 5/6) fine sandy loam, yellowish brown (10YR 5/4) moist; weak coarse subangular blocky structure; soft, very friable, slightly sticky and nonplastic; few distinct clay films on faces of peds and bridging sand grains; slightly alkaline (pH 7.4); abrupt smooth boundary.
Btk—21 to 27 inches; yellowish brown (10YR 5/6) fine sandy loam, yellowish brown (10YR 5/4) moist; weak medium and coarse subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common faint clay films on faces of peds and bridging sand grains; few very fine masses of calcium carbonate; very slightly effervescent; slightly alkaline (pH 7.6); abrupt smooth boundary.
Bk—27 to 52 inches; brownish yellow (10YR 6/6) fine sandy loam, yellowish brown (10YR 5/4) moist; weak medium and coarse subangular blocky structure; hard, firm, slightly sticky and slightly plastic; 1 percent sandstone gravel; common fine and medium masses of calcium carbonate; strongly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.
Ck—52 to 62 inches; brownish yellow (10YR 6/6) fine sandy loam, light yellowish brown (10YR 6/4) moist; massive; hard, firm, nonsticky and nonplastic; 2 percent sandstone gravel; few very fine masses of calcium carbonate; violently effervescent; moderately alkaline (pH 8.2); clear wavy boundary.
Cr—62 inches; soft weathered sandstone.

Range in Characteristics

Particle-size control section: 10 to 18 percent clay
Rock fragments: 0 to 5 percent gravel. All fragments are sandstone.
Depth to bedrock: 60 to more than 80 inches to shale or hard sandstone bedrock
Gypsum: None
Salinity: 0 to 2 mmhos/cm (nonsaline)
Sodicity: 0 to 2 SAR (slightly sodic)

A horizon:
Hue: 10YR
Value: 5 or 6 dry; 4 or 5 moist
Chroma: 3 to 6 dry and moist
Texture: loamy fine sand or fine sandy loam
Reaction: slightly alkaline

Bt horizon:
Hue: 10YR
Value: 4 to 6 dry; 3 to 5 moist
Chroma: 4 to 6 dry and moist
Texture: loamy fine sand or fine sandy loam
Reaction: slightly alkaline to moderately alkaline

Btk, Bk, and Ck horizon:
Hue: 10YR
Value: 5 or 6 dry; 4 to 6 moist
Chroma: 4 to 6 dry and moist
Texture: loamy fine sand, fine sandy loam, or loam
Calcium carbonate equivalent: 0 to 15 percent
Reaction: moderately alkaline

Skyvillage Series

Taxonomic class: Loamy, mixed, superactive, calcareous, mesic Lithic Ustic Torriorthents
Depth class: Very shallow and shallow
Drainage class: Well drained
Permeability: Moderately rapid
Geomorphic position: Structural benches on escarpments
Parent material: Eolian material and slope alluvium derived from sandstone
Slope range: 2 to 20 percent
Elevation: 6,400 to 6,800 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 10 to 13 inches
Frost-free period: 100 to 135 days

Typical Pedon

Skyvillage extremely gravelly sandy loam, in an area of mapping unit 290, Rock outcrop-Westmion-Skyvillage complex. 30 to 80 percent slopes; San Juan County, New Mexico; Pueblo Bonito Quadrangle; 1,600 feet east and 1,200 feet north of the southwest corner of sec. 27, T. 21 N., R. 10 W.; UTM: 13S 02-39-492, 39-89-679.

A—0 to 3 inches; light yellowish brown (10YR 6/4) extremely gravelly sandy loam, yellowish brown (10YR 5/4) moist; massive; loose, very friable, nonsticky and nonplastic; common very fine roots; 60 percent gravel and 1 percent cobbles; violently effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.
C—3 to 11 inches; light yellowish brown (10YR 6/4) gravelly sandy loam, yellowish brown (10YR 5/4) moist; massive; loose, very friable, nonsticky and nonplastic; few very fine roots; 30 percent gravel; violently effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.
R—11 inches; hard sandstone.

Range in Characteristics

Particle-size control section: 10 to 27 percent
Depth to lithic contact: 6 to 20 inches to sandstone
Calcium carbonate equivalent: 0 to 10 percent
Gypsum: 0 to 1 percent
Salinity: 0 to 2 mmhos/cm (nonsaline)
Sodicity: 0 SAR (nonsodic)
Reaction: slightly to moderately alkaline in the surface and moderately alkaline in the subsoil

A horizon:
Hue: 10YR or 2.5Y
Value: 5 or 6 dry; 4 or 5 moist
Chroma: 4 or 6 dry and moist
Texture: sandy loam, fine sandy loam or loamy fine sand
Rock fragments: 5 to 65 percent total; 5 to 60 percent gravel, 0 to 10 percent cobbles. All fragments are sandstone.

C horizon:
Hue: 10YR or 2.5Y
Value: 5 or 6 dry, 4 or 5 moist
Chroma: 4 or 6 dry and moist
Textures: sandy loam or fine sandy loam
Rock fragments: 0 to 30 percent total; 0 to 30 percent gravel. All fragments are sandstone.

Westmion Series

Taxonomic class: Clayey, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents
Depth class: Very shallow and shallow
Drainage class: Well
Permeability: Slow
Geomorphic position: Escarpments on cuestas and mesas
Parent material: Slope alluvium and colluvium over residuum derived from shale
Slope range: 30 to 50 percent
Elevation: 6,400 to 6,800 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 10 to 13 inches
Frost-free period: 100 to 135 days

Typical Pedon

Westmion gravelly clay loam, in an area of mapping unit 290, Rock outcrop-Westmion-Skyvillage complex, 30 to 80 percent slopes; San Juan County, New Mexico; Pueblo Bonito Quadrangle; 1,700 feet east and 1,900 feet north of the southwest corner of sec. 34, T. 21 N., R. 10 W.; UTM: 13S 02-39-742, 39-88-369.

A—0 to 2 inches; light yellowish brown (2.5Y 6/4) gravelly clay loam, light olive brown (2.5Y 5/4) moist; moderate very fine granular structure; soft, very friable, sticky and plastic; few very fine and fine roots; 15 percent gravel and 5 percent channers; very slightly effervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.
C—2 to 8 inches; light yellowish brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist; massive; hard, firm, sticky and plastic; few very fine and fine roots; few very fine irregular pores; many shale fragments; very slightly effervescent; slightly alkaline (pH 7.8); clear wavy boundary.
Cr—8 inches; shale

Range in Characteristics

Particle-size control section: 35 to 60 percent clay
Depth to paralithic contact: 6 to 20 inches to shale
Calcium carbonate equivalent: 1 to 5 percent
Gypsum: 0 to 2 percent
Salinity: 0 to 2 mmhos/cm (nonsaline)
Sodicity: 0 to 5 SAR (slightly sodic)
Reaction: slightly to moderately alkaline

A horizon:
Hue: 2.5Y
Value: 6 dry, 5 moist
Chroma: 4 dry or moist
Rock fragments: 10 to 40 percent total; 10 to 40 percent gravel or channers, 0 to 10 percent cobbles, 0 to 5 percent stones. All fragments are sandstone

C horizon:
Hue: 2.5Y
Value: 6 dry, 5 moist
Chroma: 4 dry or moist
Texture: clay loam or clay

Yelives Series

Taxonomic class: Coarse-loamy, mixed, superactive, calcareous, mesic Typic Torrifluvents
Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate to moderately rapid
Geomorphic position: Flood plains and alluvial fans
Parent material: Fan and stream alluvium derived from sandstone and shale
Slope range: 0 to 5 percent
Elevation: 6,000 to 6,300 feet
Mean annual air temperature: 48 to 50 degrees F.
Mean annual precipitation: 8 to 10 inches
Frost-free period: 100 to 135 days

Typical Pedon

Yelives fine sandy loam, in an area of mapping unit 4, Yelives-Beebe fine sandy loams, 1 to 5 percent slopes; San Juan County, New Mexico; Sargent Ranch Quadrangle; 900 feet east and 600 feet south of the northwest corner of sec. 23, T. 21 N., R. 10 W.; UTM: 13S 02-41-163, 39-92-378.

A—0 to 3 inches; light olive brown (2.5Y 5/4) fine sandy loam, olive brown (2.5Y 4/4) moist; massive; loose, loose, slightly sticky and nonplastic; common very fine roots; strongly effervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.
C1—3 to 8 inches; light olive brown (2.5Y 5/4) stratified loam, olive brown (2.5Y 4/4) moist; weak coarse subangular blocky and weak thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; thin strata of silt and very fine sand; common very fine roots; few very fine and fine irregular pores; strongly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.
C2—8 to 28 inches; light olive brown (2.5Y 5/4) stratified fine sandy loam, olive brown (2.5Y 4/4) moist; weak fine, medium, and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; thin strata of silt and very fine sand; common very fine roots; few very fine and fine irregular pores; strongly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.
Ck1—28 to 42 inches; light olive brown (2.5Y 5/4) loamy fine sand, light olive brown (2.5Y 5/4) moist; single grain; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; few very fine and fine irregular pores; 1 percent gravel; few very fine filaments of calcium carbonate; strongly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.
Ck2—42 to 55 inches; olive yellow (2.5Y 6/6) fine sandy loam, light olive brown (2.5Y 5/6) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; few very fine filaments of calcium carbonate; strongly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.
Ck3—55 to 70 inches; olive yellow (2.5Y 6/6) loamy fine sand, light olive brown (2.5Y 5/6) moist; single grain; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; few very fine filaments of calcium carbonate; strongly effervescent; moderately alkaline (pH 8.0).

Range in Characteristics

Particle-size control section: 8 to 20 percent clay
Rock fragment content: 0 to 10 percent sandstone
Calcium carbonate equivalent: 1 to 5 percent
Gypsum maximum: 0 to 1 percent
Salinity: 0 to 2 mmhos/cm (nonsaline)
Sodicity: 0 to 2 SAR (slightly sodic)
Reaction: Slightly to moderately alkaline

A horizon:

Hue: 2.5Y
Value: 4 to 6 dry and moist
Chroma: 2 to 4 dry and moist
Textures: loamy fine sand, fine sandy loam, or silt loam

Ck and C horizons:

Hue: 2.5Y
Value: 4 to 6 dry and moist
Chroma: 2 to 6 dry and moist
Texture: coarse sand, loamy fine sand, fine sandy loam, loam, very fine sandy loam, or silt loam

Some pedons have a thin Bw horizon.

Formation of the Soils

Factors of Soil Formation

Soil is a natural, three-dimensional body on the surface of the earth that supports plants. Although the soil mantle on the earth's surface varies widely in many places, all soils have some things in common. They all consist of minerals, organic matter, living organisms, water, and air that occur in varying amounts in different soils.

Soil results from the action of soil-forming processes on materials deposited or accumulated by geological processes. The characteristics of the soil at any given point are determined by five factors: (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material accumulated and has existed since accumulation, (3) the plant and animal life on and in the soil, (4) the topography, or lay of the land, and (5) the length of time that the forces of soil formation have acted on the parent material (Jenny, 1980; Buol, 1980). These factors of soil formation are interdependent, and few generalizations can be made regarding any one factor unless the effects of the others are known. Soil horizons are continually evolving in response to these factors.

Parent Material

Parent material is the unconsolidated material in which the soil forms. It may have weathered in place from rock, or it may have been transported by water, wind, or ice. The parent material of the soils in the survey area was derived from two sources, local material derived from the Cretaceous Mesa Verde Group and windblown material from points farther west. Parent material can be put into six general groups: residuum, colluvium, slope alluvium, fan alluvium, stream alluvium, and eolian sand. Soils can form from a single parent material or a combination of parent materials.

Residuum is unconsolidated, weathered, or partly weathered mineral material that accumulated by the disintegration of bedrock in place. An example of a soil with this type of parent material is the Persayo series.

Colluvium is unconsolidated earth material deposited on and at the base of moderately steep and steep slopes by mass wasting (direct gravitational action) and local runoff. An example of a soil with this type of parent material is the Hospah series.

Alluvium is unconsolidated material deposited by running water, including gravel, sand, silt, clay, and various mixtures of these. Slope alluvium is moved from steep slopes to more gentle slopes. An example of a soil with this type of parent material is the Chacoan series. Fan alluvium is moved along alluvial fans. Examples of soils having this type of parent material are the Beebe and Yelives series. Streams deposit stream alluvium. An example of a soil having this type of parent material is the Battlerock series. Alluvial parent material can come from more than one source.

Eolian parent material pertains to material transported and deposited by the wind. It results in dune formations. The Razito series is an example of eolian sand parent material.

Climate

Climate, past and present, is a major factor of soil formation. Temperature and moisture affect the weathering of parent material, the release and leaching and/or accumulation of nutrients, and the activity of micro-organisms. They also influence the native plant community on the soil, which in turn influences soil formation. Wind and water transport soil material over long distances, and solar radiation affects soil moisture retention and the oxidation of organic matter on the surface. In general, weathering processes increase with both temperature and moisture.

Plant and Animal Life

The effects of plants, animals, and humans are important in soil formation. Where the temperature is suitable for their growth, plants begin to grow as soon as they receive suitable amounts of water and nutrients. Plants, including fungi, influence soil formation by returning residues to the soil and aiding in

decomposition. Plants influence the temperature of the soil by providing shade during warm periods and by helping to reduce evaporation from the soil surface. Vegetation also affects the transfer of minerals within the soil, the soil pH, and, in conjunction with climate and topography, the movement of material by leaching.

Bacteria, nematodes, and other forms of animal life aid in the weathering of minerals and the decomposition of organic matter. The larger animals, such as ants, earthworms, gophers, skunks, and reptiles, turn and mix the soil during burrowing activities, altering the soil.

Humans can have a strong influence on soil formation. Tillage and overgrazing may accelerate erosion. Changes in drainage conditions or topography induced by land shaping also influence the soil. Modifications in natural fertility by fertilizers, incorporation of organic residues, or cropping practices can also alter the soil-forming process.

As a rule, humans, plants, animals, insects, bacteria, and fungi affect the formation of soils by increasing the content of organic matter, producing gains or losses in plant nutrients, mixing soil layers, and changing structure and porosity.

Topography

Topography and runoff influence the formation of soils by affecting drainage, erosion, soil temperature, and plant cover. The thickness and the kind of soil horizons depend on the amount of water that percolates through the parent material. Normally, more water enters a soil that is nearly level or gently sloping than a soil that is strongly sloping or steep. The topography of the survey area is very diverse, ranging from very steep slopes (50 percent or more) to nearly flat concave basin floors and valleys (fig. 13).

The amount of runoff depends on the slope. Steeper slopes have a higher amount of runoff than do gentle slopes. Coarse-textured soils take in water more rapidly than do fine-textured soils, so less water is lost through runoff on slopes that have coarse-textured soils than on those having fine-textured soils.

Aspect affects soil formation in the moderate to high elevations. Soils are slightly deeper on the north- and east-facing slopes because rainfall is more effective, temperatures are cooler, and plants are more numerous.

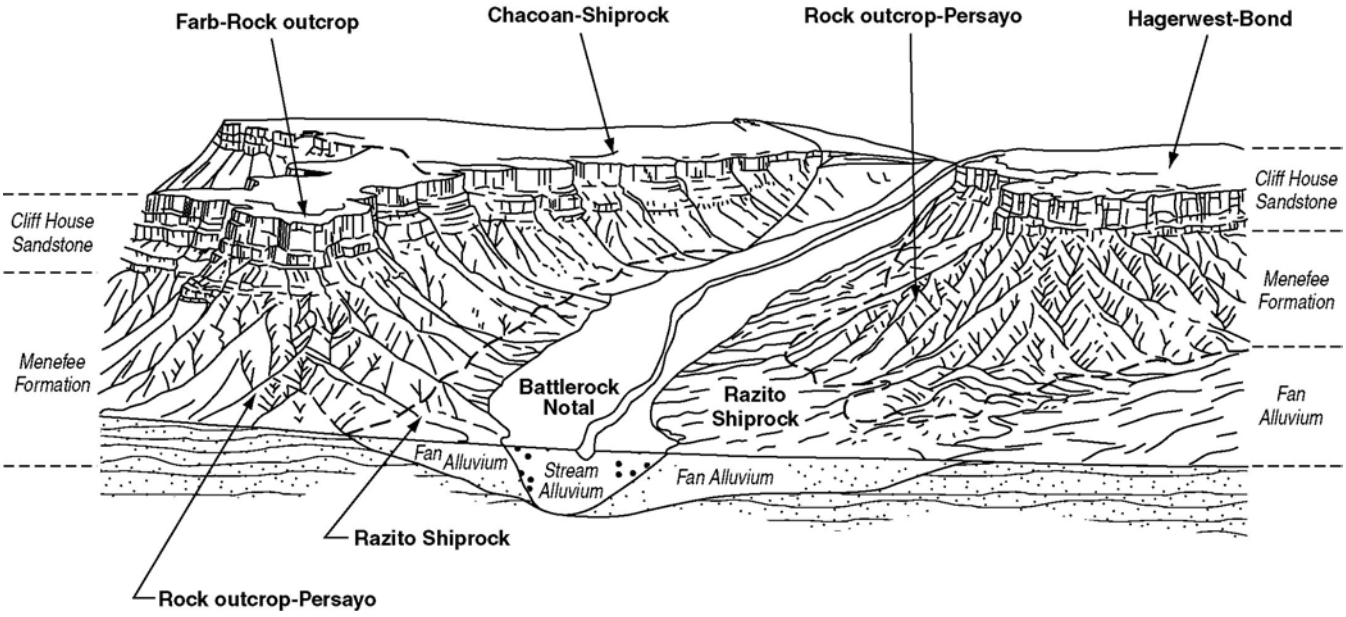

Figure 13.—Generalized relationship of soils in the survey area.

Time

The soils of the area range from old to very young. The kind of horizons and the degree of soil formation depend in part on how long the soil has remained stable.

In this survey area, the youngest soils that show the least development are on flood plains and stream terraces. The parent material of these soils has been in place only a short period. Examples of these soils are the Battlerock, Notal, and Escawetter series.

Soils on alluvial fans and fan remnants show greater development. Deposition of parent material still occurs on alluvial fans. Fan remnants are relict alluvial fans that have been dissected and no longer have active deposition of parent material. Argillic horizons have developed, and calcium carbonate is accumulating. The younger soils in this group include the Beebe and Yelives series. The older soils in this group are generally higher in clay and of a redder color. These include the Chacoan and Shiprock series.

Landforms of the Survey Area

The survey area is part of the Colorado Plateau physiographic province, and is generally characterized by rough, broken terrain, including small, steep mountainous areas, plateaus, cuestas, and mesas intermingled with steep canyon walls, escarpments, and valleys (Ruhe, 1956).

The following are landforms recognized in the survey area and some of the soils associated with them. Landforms are not static; they are continually being created and eroded.

Alluvial Fans

Alluvial fans originate from upslope landscapes. Sediment loads are deposited when slope gradients change from upland positions to less sloping landforms. An inherent feature of fan development is the continuously changing pattern of channels and loci of deposition. Over a long period of time, these changes ensure the maintenance of fans formed by distributing material widely over the surface. The soils on this landscape position are generally very deep with soil textures that are highly variable depending on the local geology. Soil series found on alluvial fan positions are the Beebe and Yelives series.

Dunes

This landform has developed from Holocene-age and present-day eolian sands. These relatively small transverse dunes formed perpendicular to the prevailing winds. Most dunes in this area are stable because vegetation that restricts their activity has been established. Dunes can be found as a component on most of the other landforms portrayed in this section. These soils can be very deep and located in large dune fields or they can occur as a shallow mantle over bedrock-controlled surfaces. The Razito series is found on dunes.

Escarpments

Escarpments are a familiar feature in the survey area. They are relatively steep slopes or cliffs produced by erosion and faulting. Because of the steepness of the slopes, soils formed on this landform are generally shallow. Examples of soil series on escarpments are the Skyvillage and Persayo series.

Fan Remnants

Soils on this position exhibit different degrees of pedogenic (soil) development. The degree of development depends upon the amounts of translocated calcium carbonate and/or clays, which are related to the age of the soil.

Fan remnants have been dissected or downcut to the point at which flooding rarely occurs. This landform has two important components. One is the summit, where erosional activity is relatively low. This area will show the different degrees of soil development and age. Second is the sideslope, where erosional activity is cutting uphill into the more stable summit. In most areas of the survey, the surface has a thick eolian mantle that is being eroded.

Soils on fan remnants vary greatly in their makeup. The Shiprock series can be found on summits of fan remnants.

Flood Plains

This landform is formed by early Holocene-age to present-day stream alluvium. In this survey area, floodwaters flow at low to very low gradients along valley floors and are elongated. The soils on these flood plains receive periodic depositions of fresh alluvium, causing an irregular decrease in organic carbon and weak to no soil development. Soils on this landform are predominantly very deep and have soil textures that are highly variable, depending on the local geology. The Escawetter and Yelives soils are formed in flood plains.

Mesas and Cuestas

These landforms have two important components. The first is the mesa summit and the cuesta dipslope. They are both nearly level to gently sloping, bedrock-

controlled surfaces that are generally stable. The Chacoan and Shiprock series are found on these surfaces. The soils are characterized by well-developed argillic horizons.

The second component is the escarpment, where erosional activity is cutting back into the more stable summit. Soils on this component have little or no horizon development because of the steep slopes where erosional activity is greatest. Typical soils representing this escarpment component are the Hospah and Skyvillage series.

Mesas differ from cuestas in that an escarpment on all sides terminates the mesa summit, whereas a cuesta will generally have one or more sides that grade into the surrounding terrain following gentle slopes.

Stream Terraces

This position is the erosional remnant of the active flood plains that existed during the late Pleistocene to Holocene ages. The slopes are in the same general direction as the current flood plain. The soils in this position are underlain by stratified sand, gravel, loamy, silty, or clayey sediments and, in some cases, buried paleosols.

The soils on stream terraces have been stable for a sufficient time period to form cambic horizons. Formation of soil structure and accumulations of calcium carbonate and sometimes gypsum characterize a cambic horizon. This position is still subject to some flooding during major events. These rare flooding occurrences and the thin alluvial deposits from the floodwaters do not inhibit soil development. Typical soils found on stream terraces are the Battlerock and Notal series.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such a soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well-aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Arroyo. The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in alluvium.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Backslope. The position that forms the steepest and generally linear, middle portion of a hillslope. In profile, backslopes are commonly bounded by a convex shoulder above and a concave footslope below.

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Biological soil crusts. (See Microbiotic crusts.)

Blowout. A shallow depression from which all or most of the soil material has been removed by the wind. A blowout has a flat or irregular floor formed by a

resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks. The steep and very steep broken land at the border of an upland summit that is dissected by ravines.

Brush management. Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Butte. An isolated small mountain or hill with steep or precipitous sides and a top variously flat, rounded, or pointed that may be a residual mass isolated by erosion or an exposed volcanic neck.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Canyon. A long, deep, narrow, very steep sided valley with high, precipitous walls in an area of high local relief.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channery soil material. Soil material that has, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that has 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

COLE (coefficient of linear extensibility). See Linear extensibility.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a plane. They typically take the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

Conglomerate. A coarse grained, clastic rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured

material. Conglomerate is the consolidated equivalent of gravel.

Consistence, soil. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coppice dune. A small dune of fine grained soil material stabilized around shrubs or small trees.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cuesta. A hill or ridge that has a gentle slope on one side and a steep slope on the other; specifically, an asymmetric, homoclinal ridge capped by resistant rock layers of slight or moderate dip.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Dip slope. A slope of the land surface, roughly determined by and approximately conforming to the dip of the underlying bedrock.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained. These classes are defined in the "Soil Survey Manual."

Drainage, surface. Runoff, or surface flow of water, from an area.

Ecological site. An area where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. An ecological site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other ecological sites in kind and/or proportion of species or in total production.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Synonym: scarp.

Fan remnant. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven dry weight, after the gravitational, or free, water has

drained away; the field moisture content 2 or 3 days after a soaking rain; also called normal field capacity, normal moisture capacity, or capillary capacity.

Fine textured soil. Sandy clay, silty clay, or clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flaggy soil material. Material that has, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Foothill. A steeply sloping upland that has relief of as much as 1,000 feet (300 meters) and fringes a mountain range or high-plateau escarpment.

Footslope. The position that forms the inner, gently inclined surface at the base of a hillslope. In profile, footslopes are commonly concave. A footslope is a transition zone between upslope sites of erosion and transport (shoulders and backslopes) and downslope sites of deposition (toeslopes).

Forb. Any herbaceous plant not a grass or a sedge.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that has 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Ground water. Water filling all the unblocked pores of the material below the water table.

Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Head slope. A geomorphic component of hills consisting of a laterally concave area of a hillside, especially at the head of a drainageway. The overland waterflow is converging.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

O horizon. An organic layer of fresh and decaying plant residue.

A horizon. The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon. The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon. The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon. The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon. Soft, consolidated bedrock beneath the soil.

R layer. Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil

properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Interfluve. An elevated area between two drainageways that sheds water to those drainageways.

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

Saturated hydraulic conductivity. (See Permeability.)

Leaching. The removal of soluble material from soil or other material by percolating water.

Linear extensibility. Refers to the change in length of an unconfined clod as moisture content is decreased from a moist to a dry state. Linear extensibility is used to determine the shrink-swell potential of soils. It is an expression of the volume change between the water content of the clod at 1/3 or 1/10 bar tension (33kPa or 10kPa tension) and oven dryness. Volume change is influenced by the amount and type of clay minerals in the soil. The volume change is the percent change for the whole soil. If it is expressed as a fraction, the resulting value is COLE, coefficient of linear extensibility.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Microbiotic crusts. Microbiotic crusts are formed by living organisms and their by-products, creating a surfact crust of soil particles bound together by organic materials. These crusts are commonly found in semi-arid and arid environments throughout the world.

Major Land Resource Area. These are geographically associated land resource units. Identification of these large areas is important in statewide agricultural planning and has value in interstate, regional and national planning.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds

making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mesa. A broad, nearly flat topped and commonly isolated upland mass characterized by summit widths that are more than the heights of bounding erosional scarps.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Microbiotic crusts. Microbiotic crusts are formed by living organisms and their by-products, creating a surface crust of soil particles bound together by organic materials. These crusts are commonly found in semiarid and aird environments throughout the world.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance — few, common, and many; size — fine, medium, and coarse; and contrast — faint, distinct, and prominent. The size measurements are of the diameter along the greatest dimension. Fine indicates less than 5 millimeters (about 0.2 inch); medium, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and coarse, more than 15 millimeters (about 0.6 inch).

Mudstone. Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

Munsell notation. A designation of color by degrees of three simple variables; hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Natric horizon. A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

Neutral soil. A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Paleosols. A soil that formed on a landscape in the past with distinctive morphological features resulting from a soil-forming environment that no longer exists at the site.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The movement of water through the soil.

Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as “saturated hydraulic conductivity,” which is defined in the “Soil Survey Manual.” In line with conventional usage in the engineering profession and with

traditional usage in published soil surveys, this rate of flow continues to be expressed as "permeability." Terms describing permeability, measured in inches per hour, are as follows:

Extremely slow	0.0 to 0.01 inch
Very slow	0.01 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Potential native plant community. See Climax plant community.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Salinity. The degree to which a soil is affected by soluble salts. Salinity is expressed as a electrical conductivity (EC) of a saturation extract. The solution resistance is measured in mmhos/cm. The degrees of salinity and their respective ratios are:

Non-saline	0-2
Very slightly saline	2-4
Slightly saline	4-8
Moderately saline	8-16
Strongly saline	>16

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Second bottom. The first terrace above the normal flood plain (or first bottom) of a river.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder. The position that forms the uppermost inclined surface near the top of a hillslope. It is a transition from backslope to summit. The surface is dominantly convex in profile and erosional in origin.

Shrink-Swell. Soil volume changes due to increases or decreases in moisture content. Linear extensibility is used to determine the shrink-swell potential of soils. It is an expression of the volume change between the water content of the clod at 1/3 or 1/10 bar tension and oven dryness. Volume change is influenced by the amount and type of clay minerals in the soil. The volume change is the percent change for the whole soil. If it is expressed as a fraction, the resulting value is COLE, coefficient of linear extensibility. The shrink-swell classes are defined as follows:

Class	LEP
Low	<3
Moderate	3-6
High	6-9
Very High	>9

Side slope. A geomorphic component of hills consisting of a laterally planar area of a hillside. The overland waterflow is predominantly parallel.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil generally is silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical

distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey, classes for simple slopes are as follows:

Nearly level	0 to 1 percent
Gently sloping	1 to 5 percent
Strongly sloping	5 to 12 percent
Moderately steep	12 to 20 percent
Steep	20 to 45 percent
Very steep	45 percent and higher

Sodic (alkali) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na to Ca + Mg. The degrees of sodicity and their respective ratios are:

Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Sodium adsorption ratio (SAR). A measure of the amount of sodium (Na) relative to calcium (Ca) and magnesium (Mg) in the water extract from saturated soil paste. It is the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration.

Soft bedrock. Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are: platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are either single grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summit. The topographically highest position of a hillslope. It has a nearly level (planar or only slightly convex) surface.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay

loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Toeslope. The position that forms the gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear and are constructional surfaces forming the lower part of a hillslope continuum that grades to valley or closed-depression floors.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Upland. Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Tables

Table 1.--Temperature and Precipitation

(Recorded in the period 1971-2000 at Chaco Culture National Historical Park)

Month	Temperature						Precipitation			
				2 years in 10 will have--				2 years in 10 will have--		
	Average daily maximum	Average daily minimum	Average	Maximum temperature higher than	Minimum temperature lower than	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more
	°F	°F	°F	°F	°F	Units	In	In	In	
January-----	42.9	12.9	27.9	62	-16	4	0.57	0.16	0.98	2
February----	49.2	18.9	34.0	66	-7	17	0.54	0.14	0.90	1
March-------	57.9	23.4	40.7	75	3	89	0.65	0.16	1.12	1
April-------	66.4	28.9	47.7	82	10	241	0.52	0.16	0.95	1
May---------	75.9	37.8	56.9	89	19	515	0.68	0.15	1.14	1
June--------	86.4	46.8	66.6	98	29	784	0.47	0.12	0.89	1
July--------	89.8	54.6	72.2	100	40	985	1.19	0.38	1.85	3
August------	87.0	53.2	70.1	97	40	922	1.31	0.63	1.89	4
September---	80.2	44.3	62.3	92	24	661	1.17	0.40	1.80	3
October-----	68.7	31.7	50.2	83	12	325	1.05	0.39	1.80	3
November----	53.8	21.2	37.5	71	-3	56	0.77	0.23	1.31	2
December----	43.9	13.6	28.8	62	-13	4	0.53	0.15	0.88	2
Yearly:										
Average---	66.9	32.3	49.6	---	---	---	---	---	---	---
Extreme---	104	-37	---	100	-22	---	---	---	---	---
Total-----	---	---	---	---	---	4,603	9.45	7.05	11.41	14

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minumum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees. F)

Table 2.--Freeze Dates in Spring and Fall

(Recorded in the period 1971-2000 at Chaco Culture National Historical Park)

	24 °F	28 °F	32 °F
Last freezing temperature in spring:			
1 year in 10 later than--	May 24	June 3	June 23
2 years in 10 later than--	May 15	May 27	June 16
5 years in 10 later than--	May 5	May 14	June 2
First freezing temperature in fall:			
1 year in 10 earlier than--	September 24	September 18	September 12
2 years in 10 earlier than--	September 29	September 23	September 17
5 years in 10 earlier than--	October 9	October 1	September 25

Table 3.--Growing Season

(Recorded in the period 1971-2000 at Chaco Culture National Historical Park)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	132	117	93
8 years in 10	140	125	101
5 years in 10	157	141	116
2 years in 10	174	156	131
1 year in 10	183	164	139

Table 4.--Acreage and Proportionate Extent of the Soils

Map symbol	Soil name	Acres	Percent
2	Battlerock-Notal complex, 0 to 1 percent slopes	2,898	8.5
3	Beebe silt loam, 0 to 1 percent slopes	101	0.3
4	Yelives-Beebe fine sandy loams, 1 to 5 percent slopes	1,304	3.8
5	Farb-Rock outcrop complex, 5 to 20 percent slopes	2,478	7.3
6	Chacoan-Shiprock loamy fine sands, 1 to 8 percent slopes	5,231	15.4
7	Chacoan-Kimnoli loamy fine sands, 1 to 3 percent slopes	659	1.9
8	Notal silty clay loam, 0 to 1 percent slopes	180	0.5
9	Doak silt loam, 1 to 5 percent slopes	765	2.3
10	Yelives fine sandy loam, 0 to 1 percent slopes	238	0.7
12	Riverwash	131	0.4
13	Escawetter fine sand, 0 to 1 percent slopes	155	0.5
16	Rock outcrop-Persayo complex, 20 to 70 percent slopes	10,814	31.9
17	Razito loamy fine sand, 5 to 45 percent slopes	797	2.3
110	Benally-Fruitland association, 1 to 5 percent slopes	367	1.1
115	Razito-Shiprock complex, 3 to 8 percent slopes	2,352	6.9
116	Fajada-Huerfano-Benally complex, 1 to 5 percent slopes	1,715	5.1
121	Badland	476	1.4
220	Hagerwest-Bond fine sandy loams, 1 to 8 percent slopes	1,085	3.2
250	Hospah-Skyvillage-Rock outcrop complex, 2 to 35 percent slopes	253	0.7
290	Rock outcrop-Westmion-Skyvillage complex, 30 to 80 percent slopes	1,935	5.7
	Total	33,934	100.0

* Less than 0.1 percent.

Table 5.--Productivity and Characteristic Plant Communities

Map symbol and soil name	Ecological site	Total dry-weight production			Characteristic vegetation	Composition
		Favorable year	Normal year	Unfavorable year		
		Lb/acre	Lb/acre	Lb/acre		Pct
2:						
Battlerock	Clay Loam Terrace (sodic) 5-8"pz	600	500	400	mound saltbush	30
					galleta	25
					greasewood	10
					alkali sacaton	5
Notal	Clay Loam Terrace (sodic) 5-8"pz	600	500	400	mound saltbush	30
					galleta	25
					greasewood	10
					alkali sacaton	5
3:						
Beebe	Sandy Bottom 5-8"pz	550	450	350	Indian ricegrass	20
					saltcedar	20
					western wheatgrass	17
					alkali sacaton	12
					fourwing saltbush	10
					sand dropseed	5
					galleta	3
					miscellaneous perennial forbs	3
					other annual forbs	2
					miscellaneous perennial grasses	2
					broom snakeweed	1
					common reed	1
					giant dropseed	1
					inland saltgrass	1
					rabbitbrush	1
					spike dropseed	1
4:						
Yelives	Loamy Upland 5-8"pz	550	450	350	blue grama	15
					western wheatgrass	15
					Indian ricegrass	10
					fourwing saltbush	10
					sand dropseed	10
					needle and thread	5
					other annual forbs	5
					miscellaneous perennial forbs	5
					spike dropseed	5
					galleta	3
					ring muhly	3
					rabbitbrush	1
					sand sagebrush	1
					spineless horsebrush	1
Beebe	Loamy Upland 5-8"pz	550	450	350	blue grama	15
					western wheatgrass	15
					Indian ricegrass	10
					fourwing saltbush	10
					sand dropseed	10
					needle and thread	5
					other annual forbs	5
					miscellaneous perennial forbs	5
					spike dropseed	5
					galleta	3
					ring muhly	3
					rabbitbrush	1
					sand sagebrush	1
					spineless horsebrush	1

Table 5.--Productivity and Characteristic Plant Communities--Continued

Map symbol and soil name	Ecological site	Total dry-weight production			Characteristic vegetation	Composition
		Favorable year	Normal year	Unfavorable year		
		Lb/acre	Lb/acre	Lb/acre		Pct
5:						
Farb	Sandstone Upland 5-8"pz	250	175	100	Indian ricegrass	20
					Bigelow sagebrush	10
					galleta	10
					Ephedra	5
					New Mexico Feathergrass	5
					black grama	5
					blue grama	5
					fourwing saltbush	5
					sand dropseed	5
					shadscale saltbush	5
					sideoats grama	5
					other annual forbs	3
					miscellaneous perennial forbs	2
					narrowleaf yucca	1
Rock outcrop	---	---	---	---	---	---
6:						
Chacoan	Sandy Loam Upland 5-8"pz	550	400	300	Indian ricegrass	30
					blue grama	10
					galleta	10
					fourwing saltbush	5
					winterfat	5
					bottlebrush squirreltail	3
					miscellaneous perennial forbs	3
					other annual forbs	2
					sand dropseed	2
					broom snakeweed	1
					rabbitbrush	1
					sandhill muhly	1
Shiprock	Sandy Loam Upland 5-8"pz	550	400	300	Indian ricegrass	30
					blue grama	10
					galleta	10
					fourwing saltbush	5
					winterfat	5
					bottlebrush squirreltail	3
					miscellaneous perennial forbs	3
					other annual forbs	2
					sand dropseed	2
					broom snakeweed	1
					rabbitbrush	1
					sandhill muhly	1
7:						
Chacoan	Sandy Loam Upland 5-8"pz	550	400	300	Indian ricegrass	30
					blue grama	10
					galleta	10
					fourwing saltbush	5
					winterfat	5
					bottlebrush squirreltail	3
					miscellaneous perennial forbs	3
					other annual forbs	2
					sand dropseed	2
					broom snakeweed	1
					rabbitbrush	1
					sandhill muhly	1

Table 5.--Productivity and Characteristic Plant Communities--Continued

Map symbol and soil name	Ecological site	Total dry-weight production			Characteristic vegetation	Composition
		Favorable year	Normal year	Unfavorable year		
		Lb/acre	Lb/acre	Lb/acre		Pct
7:						
Kimnoli	Sandstone Upland 5-8"pz	250	200	100	Indian ricegrass	20
					Bigelow sagebrush	10
					galleta	10
					New Mexico Feathergrass	5
					black grama	5
					blue grama	5
					fourwing saltbush	5
					mormon tea	5
					sand dropseed	5
					shadscale saltbush	5
					sideoats grama	5
					other annual forbs	3
					miscellaneous perennial forbs	2
					narrowleaf yucca	1
8:						
Notal	Clay Loam Terrace (sodic) 5-8"pz	600	500	400	mound saltbush	30
					galleta	25
					greasewood	10
					alkali sacaton	5
9:						
Doak	Loamy Upland 5-8"pz	550	400	350	galleta	25
					Indian ricegrass	15
					fourwing saltbush	10
					alkali sacaton	5
					black grama	5
					blue grama	5
					bottlebrush squirreltail	5
					miscellaneous perennial forbs	3
					rabbitbrush	3
					winterfat	3
					sand dropseed	2
					other annual forbs	1
10:						
Yelives	Sandy Bottom 5-8"pz	550	450	350	Indian ricegrass	20
					saltcedar	20
					western wheatgrass	17
					alkali sacaton	12
					fourwing saltbush	10
					sand dropseed	5
					galleta	3
					miscellaneous perennial forbs	3
					other annual forbs	2
					miscellaneous perennial grasses	2
					broom snakeweed	1
					common reed	1
					giant dropseed	1
					inland saltgrass	1
					rabbitbrush	1
					spike dropseed	1
12:						
Riverwash	---	---	---	---	---	---

Table 5.--Productivity and Characteristic Plant Communities--Continued

Map symbol and soil name	Ecological site	Total dry-weight production			Characteristic vegetation	Composition
		Favorable year	Normal year	Unfavorable year		
		Lb/acre	Lb/acre	Lb/acre		Pct
13:						
Escawetter	Sandy Bottom (subirr) 5-8"pz	1,000	800	600	alkali sacaton	20
					inland saltgrass	20
					Indian ricegrass	10
					miscellaneous perennial grasses	5
					saltcedar	5
					sand dropseed	5
					western wheatgrass	5
					Russian-olive	3
					miscellaneous perennial forbs	3
					bottlebrush squirreltail	2
16:						
Rock outcrop	---	---	---	---	---	---
Persayo	Sandstone Upland 5-8"pz	250	175	100	Indian ricegrass	20
					Bigelow sagebrush	10
					galleta	10
					New Mexico Feathergrass	5
					black grama	5
					blue grama	5
					fourwing saltbush	5
					mormon tea	5
					sand dropseed	5
					shadscale saltbush	5
					sideoats grama	5
					other annual forbs	3
					miscellaneous perennial forbs	2
					narrowleaf yucca	1
17:						
Razito	Sandy Upland	500	350	250	Indian ricegrass	20
					mormon tea	10
					blue grama	5
					galleta	5
					sand dropseed	5
					sandhill muhly	5
					spike dropseed	3
					broom snakeweed	2
					fourwing saltbush	2
					giant dropseed	2
					needle and thread	2
					other annual forbs	2
					miscellaneous perennial forbs	2
					rabbitbrush	2
					winterfat	1
110:						
Benally	Loamy Upland (sodic) 5-8"pz	500	400	300	alkali sacaton	25
					mound saltbush	15
					galleta	10
					Indian ricegrass	5
					blue grama	3
					other annual forbs	3
					miscellaneous perennial forbs	2
					sand dropseed	1
					shadscale saltbush	1

Table 5.--Productivity and Characteristic Plant Communities--Continued

Map symbol and soil name	Ecological site	Total dry-weight production			Characteristic vegetation	Composition
		Favorable year	Normal year	Unfavorable year		
		Lb/acre	Lb/acre	Lb/acre		Pct
110:						
Fruitland	Sandy Upland 5-8"pz	500	400	300	Indian ricegrass	30
					blue grama	10
					galleta	10
					fourwing saltbush	5
					winterfat	5
					bottlebrush squirreltail	3
					miscellaneous perennial forbs	3
					other annual forbs	2
					sand dropseed	2
					broom snakeweed	1
					rabbitbrush	1
					sandhill muhly	1
115:						
Razito	Sandy Upland 5-8"pz	500	350	250	Indian ricegrass	20
					mormon tea	10
					blue grama	5
					galleta	5
					sand dropseed	5
					sandhill muhly	5
					spike dropseed	3
					broom snakeweed	2
					fourwing saltbush	2
					giant dropseed	2
					needle and thread	2
					other annual forbs	2
					miscellaneous perennial forbs	2
					rabbitbrush	2
					winterfat	1
Shiprock	Sandy Loam Upland 5-8"pz	550	400	300	Indian ricegrass	30
					blue grama	10
					galleta	10
					fourwing saltbush	5
					winterfat	5
					bottlebrush squirreltail	3
					miscellaneous perennial forbs	3
					other annual forbs	2
					sand dropseed	2
					broom snakeweed	1
					rabbitbrush	1
					sandhill muhly	1
116:						
Fajada	Loamy Upland (sodic) 5-8"pz	500	400	300	alkali sacaton	25
					mound saltbush	15
					galleta	10
					Indian ricegrass	5
					blue grama	3
					other annual forbs	3
					miscellaneous perennial forbs	2
					sand dropseed	1
					shadscale saltbush	1

Table 5.--Productivity and Characteristic Plant Communities--Continued

Map symbol and soil name	Ecological site	Total dry-weight production			Characteristic vegetation	Composition
		Favorable year	Normal year	Unfavorable year		
		Lb/acre	Lb/acre	Lb/acre		Pct
116:						
Huerfano	Loamy Upland (sodic) 5-8"pz	500	400	300	alkali sacaton	25
					mound saltbush	15
					galleta	10
					Indian ricegrass	5
					blue grama	3
					other annual forbs	3
					miscellaneous perennial forbs	2
					sand dropseed	1
					shadscale saltbush	1
Benally	Loamy Upland (sodic) 5-8"pz	500	400	300	alkali sacaton	25
					mound saltbush	15
					galleta	10
					Indian ricegrass	5
					blue grama	3
					other annual forbs	3
					miscellaneous perennial forbs	2
					sand dropseed	1
					shadscale saltbush	1
121:						
Badland	---	---	---	---	---	---
220:						
Hagerwest	Loamy	1,500	1,000	500	blue grama	20
					western wheatgrass	20
					miscellaneous perennial forbs	8
					spike muhly	8
					alkali sacaton	5
					bottlebrush squirreltail	5
					fourwing saltbush	5
					galleta	5
					other annual forbs	5
					winterfat	5
					oneseed juniper	2
					broom snakeweed	1
					rabbitbrush	1
					spineless horsebrush	1
Bond	Shallow Sandstone	700	500	275	Bigelow sagebrush	10
					blue grama	10
					fourwing saltbush	10
					Indian ricegrass	5
					New Mexico Feathergrass	5
					galleta	5
					little bluestem	5
					other annual forbs	5
					miscellaneous perennial forbs	5
					sideoats grama	5
					winterfat	5
					Ephedra	3
					cliffrose	3
					oneseed juniper	3
					twoneedle pinyon	2

Table 5.--Productivity and Characteristic Plant Communities--Continued

Map symbol and soil name	Ecological site	Total dry-weight production			Characteristic vegetation	Composition
		Favorable year	Normal year	Unfavorable year		
		Lb/acre	Lb/acre	Lb/acre		Pct
250:						
Hospah	Shale Hills	660	425	250	alkali sacaton	15
					galleta	15
					Indian ricegrass	5
					blue grama	5
					bottlebrush squirreltail	5
					fourwing saltbush	5
					little bluestem	5
					needle and thread	5
					sideoats grama	5
					western wheatgrass	5
					mound saltbush	2
					shadscale saltbush	2
					Bigelow sagebrush	1
					oneseed juniper	1
					winterfat	1
Skyvillage	Shallow Sandstone	700	475	275	Bigelow sagebrush	10
					blue grama	10
					fourwing saltbush	10
					Indian ricegrass	5
					New Mexico Feathergrass	5
					galleta	5
					little bluestem	5
					other annual forbs	5
					miscellaneous perennial forbs	5
					sideoats grama	5
					winterfat	5
					Ephedra	3
					cliffrose	3
					oneseed juniper	3
					twoneedle pinyon	2
Rock outcrop	---	---	---	---	---	---
290:						
Rock outcrop	---	---	---	---	---	---
Westmion	Foothills	750	500	375	Indian ricegrass	5
					Mormon tea	5
					blue grama	5
					cliffrose	5
					fourwing saltbush	5
					galleta	5
					little bluestem	5
					mountain mahogany	5
					sideoats grama	5
					winterfat	5
					oneseed juniper	1
					twoneedle pinyon	1

Table 5.--Productivity and Characteristic Plant Communities--Continued

Map symbol and soil name	Ecological site	Total dry-weight production			Characteristic vegetation	Composition
		Favorable year	Normal year	Unfavorable year		
		Lb/acre	Lb/acre	Lb/acre		Pct
290:						
Skyvillage	Shallow Sandstone	750	500	275	Bigelow sagebrush	10
					blue grama	10
					fourwing saltbush	10
					Indian ricegrass	5
					New Mexico Feathergrass	5
					galleta	5
					little bluestem	5
					other annual forbs	5
					miscellaneous perennial forbs	5
					sideoats grama	5
					winterfat	5
					Ephedra	3
					cliffrose	3
					oneseed juniper	3
					twoneedle pinyon	2

Table 6a.--Recreation

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the limitation. See text for further explanation of ratings in this table.)

Map symbol and soil name	Pct. of map unit	Camp areas		Picnic areas		Playgrounds	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
2:							
Battlerock	45	Very limited		Not limited		Not limited	
		Flooding	1.00				
Notal	35	Very limited		Somewhat limited		Somewhat limited	
		Flooding	1.00	Restricted permeability	0.37	Restricted permeability	0.37
		Restricted permeability	0.37				
3:							
Beebe	90	Very limited		Somewhat limited		Very limited	
		Flooding	1.00	Dusty	0.50	Flooding	1.00
		Dusty	0.50	Flooding	0.40	Dusty	0.50
4:							
Yelives	40	Very limited		Somewhat limited		Very limited	
		Flooding	1.00	Flooding	0.40	Flooding	1.00
						Slope	0.01
Beebe	45	Very limited		Somewhat limited		Very limited	
		Flooding	1.00	Flooding	0.40	Flooding	1.00
						Slope	0.01
5:							
Farb	45	Very limited		Very limited		Very limited	
		Depth to bedrock	1.00	Depth to bedrock	1.00	Depth to bedrock	1.00
		Too sandy	0.50	Too sandy	0.50	Slope	1.00
		Slope	0.16	Slope	0.16	Too sandy	0.50
Rock outcrop	45	Not rated		Not rated		Not rated	
6:							
Chacoan	50	Somewhat limited		Somewhat limited		Somewhat limited	
		Too sandy	0.50	Too sandy	0.50	Slope	0.50
						Too sandy	0.50
						Depth to bedrock	0.29
Shiprock	40	Somewhat limited		Somewhat limited		Somewhat limited	
		Too sandy	0.50	Too sandy	0.50	Slope	0.50
						Too sandy	0.50

Table 6a.--Recreation--Continued

Map symbol and soil name	Pct. of map unit	Camp areas		Picnic areas		Playgrounds	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
7:							
Chacoan	45	Somewhat limited		Somewhat limited		Somewhat limited	
		Too sandy	0.50	Too sandy	0.50	Too sandy	0.50
						Slope	0.01
Kimnoli	35	Very limited		Very limited		Very limited	
		Depth to bedrock	1.00	Depth to bedrock	1.00	Depth to bedrock	1.00
		Too sandy	0.50	Too sandy	0.50	Too sandy	0.50
						Slope	0.01
8:							
Notal	80	Very limited		Very limited		Very limited	
		Flooding	1.00	Sodium content	1.00	Sodium content	1.00
		Sodium content	1.00	Restricted permeability	0.37	Restricted permeability	0.37
		Restricted permeability	0.37				
9:							
Doak	85	Somewhat limited		Somewhat limited		Somewhat limited	
		Restricted permeability	0.60	Restricted permeability	0.60	Restricted permeability	0.60
		Dusty	0.50	Dusty	0.50	Dusty	0.50
						Slope	0.01
10:							
Yelives	90	Very limited		Somewhat limited		Very limited	
		Flooding	1.00	Flooding	0.40	Flooding	1.00
12:							
Riverwash	100	Not rated		Not rated		Not rated	
13:							
Escawetter	95	Very limited		Somewhat limited		Very limited	
		Flooding	1.00	Flooding	0.40	Flooding	1.00
16:							
Rock outcrop	40	Not rated		Not rated		Not rated	
Persayo	50	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
		Depth to bedrock	1.00	Depth to bedrock	1.00	Depth to bedrock	1.00
17:							
Razito	95	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
		Too sandy	0.50	Too sandy	0.50	Too sandy	0.50

Table 6a.--Recreation--Continued

Map symbol and soil name	Pct. of map unit	Camp areas		Picnic areas		Playgrounds	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
110:							
Benally	45	Very limited		Very limited		Very limited	
		Sodium content	1.00	Sodium content	1.00	Sodium content	1.00
		Restricted permeability	0.60	Restricted permeability	0.60	Restricted permeability	0.60
		Too sandy	0.50	Too sandy	0.50	Too sandy	0.50
						Slope	0.01
Fruitland	40	Somewhat limited		Somewhat limited		Somewhat limited	
		Too sandy	0.50	Too sandy	0.50	Too sandy	0.50
						Slope	0.01
115:							
Razito	45	Somewhat limited		Somewhat limited		Somewhat limited	
		Too sandy	0.50	Too sandy	0.50	Slope	0.87
						Too sandy	0.50
Shiprock	40	Somewhat limited		Somewhat limited		Somewhat limited	
		Too sandy	0.50	Too sandy	0.50	Slope	0.87
						Too sandy	0.50
116:							
Fajada	35	Very limited		Very limited		Very limited	
		Sodium content	1.00	Sodium content	1.00	Sodium content	1.00
						Slope	0.01
Huerfano	30	Very limited		Very limited		Very limited	
		Sodium content	1.00	Sodium content	1.00	Depth to bedrock	1.00
		Depth to bedrock	1.00	Depth to bedrock	1.00	Sodium content	1.00
		Restricted permeability	0.60	Restricted permeability	0.60	Restricted permeability	0.60
						Slope	0.01
Benally	20	Very limited		Very limited		Very limited	
		Sodium content	1.00	Sodium content	1.00	Sodium content	1.00
		Restricted permeability	0.60	Restricted permeability	0.60	Restricted permeability	0.60
						Slope	0.01
121:							
Badland	90	Not rated		Not rated		Not rated	
220:							
Hagerwest	45	Not limited		Not limited		Somewhat limited	
						Depth to bedrock	0.99
						Slope	0.50
Bond	40	Very limited		Very limited		Very limited	
		Depth to bedrock	1.00	Depth to bedrock	1.00	Depth to bedrock	1.00
						Slope	0.50

Table 6a.--Recreation--Continued

Map symbol and soil name	Pct. of map unit	Camp areas		Picnic areas		Playgrounds	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
250:							
Hospah	35	Very limited		Very limited		Very limited	
		Depth to bedrock	1.00	Depth to bedrock	1.00	Depth to bedrock	1.00
		Slope	1.00	Slope	1.00	Slope	1.00
		Restricted permeability	0.41	Restricted permeability	0.41	Restricted permeability	0.41
Skyvillage	30	Very limited		Very limited		Very limited	
		Depth to bedrock	1.00	Depth to bedrock	1.00	Depth to bedrock	1.00
		Too sandy	0.50	Too sandy	0.50	Slope	1.00
		Slope	0.16	Slope	0.16	Too sandy	0.50
Rock outcrop	25	Very limited		Very limited		Very limited	
		Depth to bedrock	1.00	Depth to bedrock	1.00	Depth to bedrock	1.00
		Slope	1.00	Slope	1.00	Slope	1.00
		Restricted permeability	1.00	Restricted permeability	1.00	Restricted permeability	1.00
290:							
Rock outcrop	45	Not rated		Not rated		Not rated	
Westmion	25	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
		Depth to bedrock	1.00	Depth to bedrock	1.00	Depth to bedrock	1.00
		Restricted permeability	0.37	Restricted permeability	0.37	Restricted permeability	0.37
Skyvillage	20	Very limited		Very limited		Very limited	
		Depth to bedrock	1.00	Depth to bedrock	1.00	Depth to bedrock	1.00
						Slope	0.87
						Gravel content	0.22

Table 6b.--Recreation

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the limitation. See text for further explanation of ratings in this table.)

Map symbol and soil name	Pct. of map unit	Paths and trails		Off-road vehicle access		Grassed walkways	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
2:							
Battlerock	45	Not limited		Not limited		Not limited	
Notal	35	Not limited		Not limited		Not limited	
3:							
Beebe	90	Somewhat limited		Somewhat limited		Very limited	
		Dusty	0.50	Dusty	0.50	Flooding	1.00
		Flooding	0.40	Flooding	0.40	Droughty	0.01
4:							
Yelives	40	Somewhat limited		Somewhat limited		Very limited	
		Flooding	0.40	Flooding	0.40	Flooding	1.00
Beebe	45	Somewhat limited		Somewhat limited		Very limited	
		Flooding	0.40	Flooding	0.40	Flooding	1.00
5:							
Farb	45	Somewhat limited		Somewhat limited		Very limited	
		Too sandy	0.50	Too sandy	0.50	Depth to bedrock	1.00
						Droughty	1.00
						Slope	0.16
Rock outcrop	45	Not rated		Not rated		Not rated	
6:							
Chacoan	50	Somewhat limited		Somewhat limited		Somewhat limited	
		Too sandy	0.50	Too sandy	0.50	Depth to bedrock	0.29
						Droughty	0.25
Shiprock	40	Somewhat limited		Somewhat limited		Not limited	
		Too sandy	0.50	Too sandy	0.50		
7:							
Chacoan	45	Somewhat limited		Somewhat limited		Somewhat limited	
		Too sandy	0.50	Too sandy	0.50	Depth to bedrock	0.90
						Droughty	0.41
Kimnoli	35	Somewhat limited		Somewhat limited		Very limited	
		Too sandy	0.50	Too sandy	0.50	Depth to bedrock	1.00
						Droughty	1.00
8:							
Notal	80	Not limited		Not limited		Very limited	
						Sodium content	1.00

Table 6b.--Recreation--Continued

Map symbol and soil name	Pct. of map unit	Paths and trails		Off-road vehicle access		Grassed walkways	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
9:							
Doak	85	Somewhat limited		Somewhat limited		Not limited	
		Dusty	0.50	Dusty	0.50		
10:							
Yelives	90	Somewhat limited		Somewhat limited		Very limited	
		Flooding	0.40	Flooding	0.40	Flooding	1.00
12:							
Riverwash	100	Not rated		Not rated		Not rated	
13:							
Escawetter	95	Somewhat limited		Somewhat limited		Very limited	
		Flooding	0.40	Flooding	0.40	Flooding	1.00
						Droughty	0.85
16:							
Rock outcrop	40	Not rated		Not rated		Not rated	
Persayo	50	Very limited		Somewhat limited		Very limited	
		Slope	1.00	Slope	0.22	Depth to bedrock	1.00
						Slope	1.00
						Droughty	1.00
17:							
Razito	95	Somewhat limited		Somewhat limited		Very limited	
		Too sandy	0.50	Too sandy	0.50	Slope	1.00
		Slope	0.50			Droughty	0.88
110:							
Benally	45	Somewhat limited		Somewhat limited		Very limited	
		Too sandy	0.50	Too sandy	0.50	Sodium content	1.00
Fruitland	40	Somewhat limited		Somewhat limited		Not limited	
		Too sandy	0.50	Too sandy	0.50		
115:							
Razito	45	Somewhat limited		Somewhat limited		Somewhat limited	
		Too sandy	0.50	Too sandy	0.50	Droughty	0.09
Shiprock	40	Somewhat limited		Somewhat limited		Not limited	
		Too sandy	0.50	Too sandy	0.50		
116:							
Fajada	35	Not limited		Not limited		Very limited	
						Sodium content	1.00
						Depth to bedrock	0.16

Table 6b.--Recreation--Continued

Map symbol and soil name	Pct. of map unit	Paths and trails		Off-road vehicle access		Grassed walkways	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
116:							
Huerfano	30	Not limited		Not limited		Very limited	
						Depth to bedrock	1.00
						Sodium content	1.00
						Droughty	1.00
Benally	20	Not limited		Not limited		Very limited	
						Sodium content	1.00
121:							
Badland	90	Not rated		Not rated		Not rated	
220:							
Hagerwest	45	Not limited		Not limited		Very limited	
						Depth to bedrock	0.99
						Droughty	0.37
Bond	40	Not limited		Not limited		Very limited	
						Depth to bedrock	1.00
						Droughty	0.99
250:							
Hospah	35	Somewhat limited		Not limited		Very limited	
		Slope	0.50			Depth to bedrock	1.00
						Slope	1.00
						Droughty	0.91
Skyvillage	30	Somewhat limited		Somewhat limited		Very limited	
		Too sandy	0.50	Too sandy	0.50	Depth to bedrock	1.00
						Droughty	1.00
						Slope	0.16
Rock outcrop	25	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Depth to bedrock	1.00
		Water erosion	1.00	Water erosion	1.00	Slope	1.00
290:							
Rock outcrop	45	Not rated		Not rated		Not rated	
Westmion	25	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Depth to bedrock	1.00
						Slope	1.00
						Droughty	1.00
Skyvillage	20	Not limited		Not limited		Very limited	
						Depth to bedrock	1.00
						Droughty	1.00

Table 7a.--Building Site Development

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the limitation. See text for further explanation of ratings in this table.)

Map symbol and soil name	Pct. of map unit	Dwellings without basements		Dwellings with basements		Small commercial buildings	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
2:							
Battlerock	45	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
		Shrink-swell	0.50	Shrink-swell	1.00	Shrink-swell	0.50
Notal	35	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
		Shrink-swell	1.00	Shrink-swell	1.00	Shrink-swell	1.00
3:							
Beebe	90	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
4:							
Yelives	40	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
Beebe	45	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
5:							
Farb	45	Very limited		Very limited		Very limited	
		Depth to hard bedrock	1.00	Depth to hard bedrock	1.00	Depth to hard bedrock	1.00
		Slope	0.16	Slope	0.16	Slope	1.00
Rock outcrop	45	Not rated		Not rated		Not rated	
6:							
Chacoan	50	Somewhat limited		Very limited		Somewhat limited	
		Depth to hard bedrock	0.29	Depth to hard bedrock	1.00	Depth to hard bedrock	0.29
						Slope	0.01
Shiprock	40	Not limited		Not limited		Somewhat limited	
						Slope	0.01
7:							
Chacoan	45	Somewhat limited		Very limited		Somewhat limited	
		Depth to hard bedrock	0.90	Depth to hard bedrock	1.00	Depth to hard bedrock	0.90
Kimnoli	35	Very limited		Very limited		Very limited	
		Depth to hard bedrock	1.00	Depth to hard bedrock	1.00	Depth to hard bedrock	1.00

Table 7a.--Building Site Development--Continued

Map symbol and soil name	Pct. of map unit	Dwellings without basements		Dwellings with basements		Small commercial buildings	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
8:							
Notal	80	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
		Shrink-swell	0.50	Shrink-swell	0.50	Shrink-swell	0.50
9:							
Doak	85	Somewhat limited		Somewhat limited		Somewhat limited	
		Shrink-swell	0.50	Shrink-swell	0.50	Shrink-swell	0.50
10:							
Yelives	90	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
12:							
Riverwash	100	Not rated		Not rated		Not rated	
13:							
Escawetter	95	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Flooding	1.00
				Depth to saturated zone	0.64		
16:							
Rock outcrop	40	Not rated		Not rated		Not rated	
Persayo	50	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
		Depth to soft bedrock	1.00	Depth to soft bedrock	1.00	Depth to soft bedrock	1.00
7:							
Razito	95	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
110:							
Benally	45	Somewhat limited		Somewhat limited		Somewhat limited	
		Shrink-swell	0.50	Shrink-swell	0.50	Shrink-swell	0.50
Fruitland	40	Not limited		Not limited		Not limited	
115:							
Razito	45	Not limited		Not limited		Somewhat limited	
						Slope	0.12
Shiprock	40	Not limited		Not limited		Somewhat limited	
						Slope	0.12

Table 7a.--Building Site Development--Continued

Map symbol and soil name	Pct. of map unit	Dwellings without basements		Dwellings with basements		Small commercial buildings	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
116:							
Fajada	35	Not limited		Somewhat limited Depth to soft bedrock	0.15	Not limited	
Huerfano	30	Somewhat limited Depth to soft bedrock Shrink-swell	1.00 0.50	Very limited Depth to soft bedrock Shrink-swell	1.00 0.50	Somewhat limited Depth to soft bedrock Shrink-swell	1.00 0.50
Benally	20	Not limited		Not limited		Not limited	
121:							
Badland	90	Not rated		Not rated		Not rated	
220:							
Hagerwest	45	Somewhat limited Depth to hard bedrock Shrink-swell	0.99 0.50	Very limited Depth to hard bedrock Shrink-swell	1.00 0.50	Very limited Depth to hard bedrock Shrink-swell Slope	0.99 0.50 0.01
Bond	40	Very limited Depth to hard bedrock	1.00	Very limited Depth to hard bedrock	1.00	Very limited Depth to hard bedrock Slope	1.00 0.01
250:							
Hospah	35	Very limited Depth to soft bedrock Shrink-swell Slope	1.00 1.00 1.00	Very limited Shrink-swell Depth to soft bedrock Slope	1.00 1.00 1.00	Very limited Depth to soft bedrock Shrink-swell Slope	1.00 1.00 1.00
Skyvillage	30	Very limited Depth to hard bedrock Slope	1.00 0.16	Very limited Depth to hard bedrock Slope	1.00 0.16	Very limited Depth to hard bedrock Slope	1.00 1.00
Rock outcrop	25	Very limited Depth to hard bedrock Slope	1.00 1.00	Very limited Depth to hard bedrock Slope	1.00 1.00	Very limited Depth to hard bedrock Slope	1.00 1.00

Table 7a.--Building Site Development--Continued

Map symbol and soil name	Pct. of map unit	Dwellings without basements		Dwellings with basements		Small commercial buildings	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
290:							
Rock outcrop	45	Not rated		Not rated		Not rated	
Westmion	25	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Slope	1.00
		Depth to soft bedrock	1.00	Shrink-swell	1.00	Depth to soft bedrock	1.00
		Shrink-swell	1.00	Depth to soft bedrock	1.00	Shrink-swell	1.00
Skyvillage	20	Very limited		Very limited		Very limited	
		Depth to hard bedrock	1.00	Depth to hard bedrock	1.00	Depth to hard bedrock	1.00
						Slope	0.12

Table 7b.--Building Site Development

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the limitation. See text for further explanation of ratings in this table.)

Map symbol and soil name	Pct. of map unit	Local roads and streets		Shallow excavations		Lawns and landscaping	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
2:							
Battlerock	45	Somewhat limited		Somewhat limited		Not limited	
		Shrink-swell	0.50	Too clayey	0.12		
		Flooding	0.40	Cutbanks cave	0.10		
Notal	35	Very limited		Somewhat limited		Not limited	
		Low strength	1.00	Too clayey	0.50		
		Shrink-swell	1.00	Cutbanks cave	0.10		
		Flooding	0.40				
3:							
Beebe	90	Very limited		Very limited		Very limited	
		Flooding	1.00	Cutbanks cave	1.00	Flooding	1.00
				Flooding	0.80	Droughty	0.01
4:							
Yelives	40	Very limited		Very limited		Very limited	
		Flooding	1.00	Cutbanks cave	1.00	Flooding	1.00
				Flooding	0.80		
Beebe	45	Very limited		Very limited		Very limited	
		Flooding	1.00	Cutbanks cave	1.00	Flooding	1.00
				Flooding	0.80		
5:							
Farb	45	Very limited		Very limited		Very limited	
		Depth to hard bedrock	1.00	Depth to hard bedrock	1.00	Depth to bedrock	1.00
		Slope	0.16	Slope	0.16	Droughty	1.00
				Cutbanks cave	0.10	Slope	0.16
Rock outcrop	45	Not rated		Not rated		Not rated	
6:							
Chacoan	50	Somewhat limited		Very limited		Somewhat limited	
		Depth to hard bedrock	0.29	Depth to hard bedrock	1.00	Depth to bedrock	0.29
				Cutbanks cave	0.10	Droughty	0.25
Shiprock	40	Not limited		Somewhat limited		Not limited	
				Cutbanks cave	0.10		

Table 7b.--Building Site Development--Continued

Map symbol and soil name	Pct. of map unit	Local roads and streets		Shallow excavations		Lawns and landscaping	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
7:							
Chacoan	45	Somewhat limited		Very limited		Somewhat limited	
		Depth to hard bedrock	0.90	Depth to hard bedrock	1.00	Depth to bedrock	0.90
				Cutbanks cave	0.10	Droughty	0.41
Kimnoli	35	Very limited		Very limited		Very limited	
		Depth to hard bedrock	1.00	Depth to hard bedrock	1.00	Depth to bedrock	1.00
				Cutbanks cave	0.10	Droughty	1.00
8:							
Notal	80	Very limited		Somewhat limited		Very limited	
		Low strength	1.00	Too clayey	0.50	Sodium content	1.00
		Shrink-swell	0.50	Cutbanks cave	0.10		
		Flooding	0.40				
9:							
Doak	85	Very limited		Somewhat limited		Not limited	
		Low strength	1.00	Cutbanks cave	0.10		
		Shrink-swell	0.50				
10:							
Yelives	90	Very limited		Very limited		Very limited	
		Flooding	1.00	Cutbanks cave	1.00	Flooding	1.00
				Flooding	0.80		
12:							
Riverwash	100	Not rated		Not rated		Not rated	
13:							
Escawetter	95	Very limited		Very limited		Very limited	
		Flooding	1.00	Cutbanks cave	1.00	Flooding	1.00
				Flooding	0.80	Droughty	0.85
				Depth to saturated zone	0.64		
16:							
Rock outcrop	40	Not rated		Not rated		Not rated	
Persayo	50	Very limited		Very limited		Very limited	
		Slope	1.00	Depth to soft bedrock	1.00	Depth to bedrock	1.00
		Depth to soft bedrock	1.00	Slope	1.00	Slope	1.00
				Cutbanks cave	0.10	Droughty	1.00

Table 7b.--Building Site Development--Continued

Map symbol and soil name	Pct. of map unit	Local roads and streets		Shallow excavations		Lawns and landscaping	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
17:							
Razito	95	Very limited		Very limited		Very limited	
		Slope	1.00	Cutbanks cave	1.00	Slope	1.00
				Slope	1.00	Droughty	0.88
110:							
Benally	45	Very limited		Somewhat limited		Very limited	
		Low strength	1.00	Cutbanks cave	0.10	Sodium content	1.00
		Shrink-swell	0.50				
Fruitland	40	Not limited		Very limited		Not limited	
				Cutbanks cave	1.00		
115:							
Razito	45	Not limited		Very limited		Somewhat limited	
				Cutbanks cave	1.00	Droughty	0.09
Shiprock	40	Not limited		Somewhat limited		Not limited	
				Cutbanks cave	0.10		
116:							
Fajada	35	Not limited		Somewhat limited		Very limited	
				Depth to soft bedrock	0.15	Sodium content	1.00
				Cutbanks cave	0.10	Depth to bedrock	0.16
Huerfano	30	Very limited		Very limited		Very limited	
		Depth to soft bedrock	1.00	Depth to soft bedrock	1.00	Depth to bedrock	1.00
		Low strength	1.00	Cutbanks cave	0.10	Sodium content	1.00
		Shrink-swell	0.50			Droughty	1.00
Benally	20	Not limited		Somewhat limited		Very limited	
				Cutbanks cave	0.10	Sodium content	1.00
121:							
Badland	90	Not rated		Not rated		Not rated	
220:							
Hagerwest	45	Very limited		Very limited		Very limited	
		Depth to hard bedrock	0.99	Depth to hard bedrock	1.00	Depth to bedrock	0.99
		Shrink-swell	0.50	Cutbanks cave	0.10	Droughty	0.37
Bond	40	Very limited		Very limited		Very limited	
		Depth to hard bedrock	1.00	Depth to hard bedrock	1.00	Depth to bedrock	1.00
				Cutbanks cave	0.10	Droughty	0.99

Table 7b.--Building Site Development--Continued

Map symbol and soil name	Pct. of map unit	Local roads and streets		Shallow excavations		Lawns and landscaping	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
250:							
Hospah	35	Very limited		Very limited		Very limited	
		Depth to soft bedrock	1.00	Depth to soft bedrock	1.00	Depth to bedrock	1.00
		Low strength	1.00	Slope	1.00	Slope	1.00
		Shrink-swell	1.00	Too clayey	0.50	Droughty	0.91
		Slope	1.00	Cutbanks cave	0.10		
Skyvillage	30	Very limited		Very limited		Very limited	
		Depth to hard bedrock	1.00	Depth to hard bedrock	1.00	Depth to bedrock	1.00
		Slope	0.16	Slope	0.16	Droughty	1.00
				Cutbanks cave	0.10	Slope	0.16
Rock outcrop	25	Very limited		Very limited		Very limited	
		Depth to hard bedrock	1.00	Depth to hard bedrock	1.00	Depth to bedrock	1.00
		Slope	1.00	Slope	1.00	Slope	1.00
				Cutbanks cave	0.10		
290:							
Rock outcrop	45	Not rated		Not rated		Not rated	
Westmion	25	Very limited		Very limited		Very limited	
		Slope	1.00	Depth to soft bedrock	1.00	Depth to bedrock	1.00
		Depth to soft bedrock	1.00	Slope	1.00	Slope	1.00
		Shrink-swell	1.00	Cutbanks cave	0.10	Droughty	1.00
Skyvillage	20	Very limited		Very limited		Very limited	
		Depth to hard bedrock	1.00	Depth to hard bedrock	1.00	Depth to bedrock	1.00
				Cutbanks cave	0.10	Droughty	1.00

Table 8a.--Sanitary Facilities

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the limitation. See text for further explanation of ratings in this table.)

Map symbol and soil name	Pct. of map unit	Septic tank absorption fields		Sewage lagoons	
		Rating class and limiting features	Value	Rating class and limiting features	Value
2:					
Battlerock	45	Very limited		Somewhat limited	
		Restricted permeability	1.00	Seepage	0.50
		Flooding	0.40	Flooding	0.40
Notal	35	Very limited		Somewhat limited	
		Restricted permeability	1.00	Flooding	0.40
		Flooding	0.40		
3:					
Beebe	90	Very limited		Very limited	
		Flooding	1.00	Flooding	1.00
		Filtering capacity	1.00	Seepage	1.00
4:					
Yelives	40	Very limited		Very limited	
		Flooding	1.00	Flooding	1.00
		Filtering capacity	1.00	Seepage	1.00
				Slope	0.01
Beebe	45	Very limited		Very limited	
		Flooding	1.00	Flooding	1.00
		Filtering capacity	1.00	Seepage	1.00
		Restricted permeability	0.50	Slope	0.01
5:					
Farb	45	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to hard bedrock	1.00
		Slope	0.16	Seepage	1.00
				Slope	1.00
Rock outcrop	45	Not rated		Not rated	

Table 8a.--Sanitary Facilities--Continued

Map symbol and soil name	Pct. of map unit	Septic tank absorption fields		Sewage lagoons	
		Rating class and limiting features	Value	Rating class and limiting features	Value
6:					
Chacoan	50	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to hard bedrock	1.00
		Restricted permeability	0.82	Seepage	1.00
				Slope	0.33
Shiprock	40	Somewhat limited		Very limited	
		Restricted permeability	0.82	Seepage	1.00
				Slope	0.33
7:					
Chacoan	45	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to hard bedrock	1.00
				Seepage	1.00
				Slope	0.01
Kimnoli	35	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to hard bedrock	1.00
				Seepage	0.18
				Slope	0.01
8:					
Notal	80	Very limited		Somewhat limited	
		Restricted permeability	1.00	Flooding	0.40
		Flooding	0.40		
9:					
Doak	85	Very limited		Somewhat limited	
		Restricted permeability	1.00	Slope	0.01
10:					
Yelives	90	Very limited		Very limited	
		Flooding	1.00	Flooding	1.00
		Filtering capacity	1.00	Seepage	1.00
		Restricted permeability	0.50		
12:					
Riverwash	100	Not rated		Not rated	

Table 8a.--Sanitary Facilities--Continued

Map symbol and soil name	Pct. of map unit	Septic tank absorption fields		Sewage lagoons	
		Rating class and limiting features	Value	Rating class and limiting features	Value
13:					
Escawetter	95	Very limited		Very limited	
		Flooding	1.00	Flooding	1.00
		Filtering capacity	1.00	Seepage	1.00
		Depth to saturated zone	1.00	Depth to saturated zone	0.78
16:					
Rock outcrop	40	Not rated		Not rated	
Persayo	50	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to soft bedrock	1.00
		Slope	1.00	Slope	1.00
				Seepage	0.18
17:					
Razito	95	Very limited		Very limited	
		Filtering capacity	1.00	Seepage	1.00
		Slope	1.00	Slope	1.00
110:					
Benally	45	Very limited		Very limited	
		Restricted permeability	1.00	Seepage	1.00
		Depth to bedrock	0.78	Depth to soft bedrock	0.42
				Slope	0.01
Fruitland	40	Very limited		Very limited	
		Filtering capacity	1.00	Seepage	1.00
		Restricted permeability	0.50	Slope	0.01
115:					
Razito	45	Very limited		Very limited	
		Filtering capacity	1.00	Seepage	1.00
				Slope	0.67
Shiprock	40	Somewhat limited		Very limited	
		Restricted permeability	0.50	Seepage	1.00
				Slope	0.67

Table 8a.--Sanitary Facilities--Continued

Map symbol and soil name	Pct. of map unit	Septic tank absorption fields		Sewage lagoons	
		Rating class and limiting features	Value	Rating class and limiting features	Value
116:					
Fajada	35	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to soft bedrock	1.00
		Restricted permeability	0.50	Seepage	1.00
				Slope	0.01
Huerfano	30	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to soft bedrock	1.00
				Slope	0.01
Benally	20	Somewhat limited		Very limited	
		Depth to bedrock	0.18	Seepage	1.00
				Slope	0.01
121:					
Badland	90	Not rated		Not rated	
220:					
Hagerwest	45	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to hard bedrock	1.00
				Seepage	0.50
				Slope	0.33
Bond	40	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to hard bedrock	1.00
				Seepage	1.00
				Slope	0.33
250:					
Hospah	35	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to soft bedrock	1.00
		Slope	1.00	Slope	1.00
Skyvillage	30	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to hard bedrock	1.00
		Slope	0.16	Slope	1.00
				Seepage	0.18
Rock outcrop	25	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to hard bedrock	1.00
		Slope	1.00	Slope	1.00

Table 8a.--Sanitary Facilities--Continued

Map symbol and soil name	Pct. of map unit	Septic tank absorption fields		Sewage lagoons	
		Rating class and limiting features	Value	Rating class and limiting features	Value
290:					
Rock outcrop	45	Not rated		Not rated	
Westmion	25	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to soft bedrock	1.00
		Slope	1.00	Slope	1.00
Skyvillage	20	Very limited		Very limited	
		Depth to bedrock	1.00	Depth to hard bedrock	1.00
				Slope	0.67
				Seepage	0.18

Table 8b.--Sanitary Facilities

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. The numbers in the value columns range from 0.01 to 1.00. The larger the value, the greater the limitation. See text for further explanation of ratings in this table.)

Map symbol and soil name	Pct. of map unit	Trench sanitary landfill		Area sanitary landfill		Daily cover for landfill	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
2:							
Battlerock	45	Somewhat limited		Somewhat limited		Very limited	
		Flooding	0.40	Flooding	0.40	Hard to compact	1.00
Notal	35	Somewhat limited		Somewhat limited		Very limited	
		Flooding	0.40	Flooding	0.40	Hard to compact	1.00
3:							
Beebe	90	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Too Sandy	1.00
		Too Sandy	1.00			Seepage	1.00
4:							
Yelives	40	Very limited		Very limited		Somewhat limited	
		Flooding	1.00	Flooding	1.00	Seepage	0.50
Beebe	45	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Too Sandy	1.00
		Too Sandy	1.00			Seepage	1.00
5:							
Farb	45	Very limited		Somewhat limited		Very limited	
		Depth to bedrock	1.00	Slope	0.16	Depth to bedrock	1.00
		Slope	0.16			Seepage	0.50
						Slope	0.16
Rock outcrop	45	Not rated		Not rated		Not rated	
6:							
Chacoan	50	Very limited		Not limited		Very limited	
		Depth to bedrock	1.00			Depth to bedrock	1.00
Shiprock	40	Not limited		Not limited		Somewhat limited	
						Seepage	0.50
7:							
Chacoan	45	Very limited		Not limited		Very limited	
		Depth to bedrock	1.00			Depth to bedrock	1.00
						Seepage	0.50
Kimnoli	35	Very limited		Not limited		Very limited	
		Depth to bedrock	1.00			Depth to bedrock	1.00
						Too acid	1.00
						Seepage	1.00

Table 8b.--Sanitary Facilities--Continued

Map symbol and soil name	Pct. of map unit	Trench sanitary landfill		Area sanitary landfill		Daily cover for landfill	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
8:							
Notal	80	Somewhat limited		Somewhat limited		Not limited	
		Flooding	0.40	Flooding	0.40		
9:							
Doak	85	Not limited		Not limited		Not limited	
10:							
Yelives	90	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Too Sandy	1.00
		Too Sandy	1.00			Seepage	1.00
12:							
Riverwash	100	Not rated		Not rated		Not rated	
13:							
Escawetter	95	Very limited		Very limited		Very limited	
		Flooding	1.00	Flooding	1.00	Too Sandy	1.00
		Depth to saturated zone	1.00	Depth to saturated zone	1.00	Seepage	1.00
		Too Sandy	1.00				
16:							
Rock outcrop	40	Not rated		Not rated		Not rated	
Persayo	40	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Depth to bedrock	1.00
		Depth to bedrock	1.00			Slope	1.00
						Too acid	1.00
						Seepage	0.50
17:							
Razito	95	Very limited		Very limited		Very limited	
		Too Sandy	1.00	Slope	1.00	Too Sandy	1.00
		Slope	1.00			Seepage	1.00
						Slope	1.00
110:							
Benally	45	Very limited		Not limited		Somewhat limited	
		Depth to bedrock	1.00			Depth to bedrock	0.42
Fruitland	40	Not limited		Not limited		Somewhat limited	
						Seepage	0.50
115:							
Razito	45	Very limited		Not limited		Very limited	
		Too Sandy	1.00			Seepage	1.00
						Too Sandy	0.50
Shiprock	40	Not limited		Not limited		Somewhat limited	
						Seepage	0.50

Table 8b.--Sanitary Facilities--Continued

Map symbol and soil name	Pct. of map unit	Trench sanitary landfill		Area sanitary landfill		Daily cover for landfill	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
116:							
Fajada	35	Very limited		Not limited		Very limited	
		Depth to bedrock	1.00			Depth to bedrock	1.00
						Seepage	0.50
Huerfano	30	Very limited		Not limited		Very limited	
		Depth to bedrock	1.00			Depth to bedrock	1.00
Benally	20	Very limited		Not limited		Somewhat limited	
		Depth to bedrock	1.00			Seepage	0.50
121:							
Badland	90	Not rated		Not rated		Not rated	
220:							
Hagerwest	45	Very limited		Not limited		Very limited	
		Depth to bedrock	1.00			Depth to bedrock	1.00
Bond	40	Very limited		Not limited		Very limited	
		Depth to bedrock	1.00			Depth to bedrock	1.00
						Seepage	0.88
250:							
Hospah	35	Very limited		Very limited		Very limited	
		Depth to bedrock	1.00	Slope	1.00	Depth to bedrock	1.00
		Slope	1.00			Slope	1.00
Skyvillage	30	Very limited		Somewhat limited		Very limited	
		Depth to bedrock	1.00	Slope	0.16	Depth to bedrock	1.00
		Too Sandy	1.00			Seepage	1.00
		Slope	0.16			Too Sandy	0.50
						Slope	0.16
Rock outcrop	25	Very limited		Very limited		Very limited	
		Depth to bedrock	1.00	Depth to bedrock	1.00	Depth to bedrock	1.00
		Slope	1.00	Slope	1.00	Slope	1.00
						Hard to compact	0.50
290:							
Rock outcrop	45	Not rated		Not rated		Not rated	
Westmion	25	Very limited		Very limited		Very limited	
		Slope	1.00	Slope	1.00	Depth to bedrock	1.00
		Depth to bedrock	1.00			Slope	1.00
Skyvillage	20	Very limited		Not limited		Very limited	
		Depth to bedrock	1.00			Depth to bedrock	1.00
						Seepage	0.50

Table 9a.--Construction Materials

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. The ratings given for the thickest layer are for the thickest layer above and excluding the bottom layer. The numbers in the value columns range from 0.00 to 0.99. The greater the value, the greater the likelihood that the bottom layer or thickest layer of the soil is a source of sand or gravel. See text for further explanation of ratings in this table.)

Map symbol and soil name	Pct. of map unit	Potential source of gravel		Potential source of sand	
		Rating class	Value	Rating class	Value
2:					
Battlerock	45	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
Notal	35	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
3:					
Beebe	90	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.90
		Thickest layer	0.00	Thickest layer	0.90
4:					
Yelives	40	Poor		Fair	
		Bottom layer	0.00	Thickest layer	0.00
		Thickest layer	0.00	Bottom layer	0.09
Beebe	45	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.06
		Thickest layer	0.00	Thickest layer	0.23
5:					
Farb	45	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
Rock outcrop	45	Not rated		Not rated	
6:					
Chacoan	50	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
Shiprock	40	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.06
7:					
Chacoan	45	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.01
Kimnoli	35	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00

Table 9a.--Construction Materials--Continued

Map symbol and soil name	Pct. of map unit	Potential source of gravel		Potential source of sand	
		Rating class	Value	Rating class	Value
8:					
Notal	80	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
9:					
Doak	85	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
10:					
Yelives	90	Poor		Fair	
		Bottom layer	0.00	Thickest layer	0.03
		Thickest layer	0.00	Bottom layer	0.99
12:					
Riverwash	100	Not rated		Not rated	
13:					
Escawetter	95	Poor		Fair	
		Bottom layer	0.00	Thickest layer	0.54
		Thickest layer	0.00	Bottom layer	0.90
16:					
Rock outcrop	40	Not rated		Not rated	
Persayo	50	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
17:					
Razito	95	Poor		Fair	
		Bottom layer	0.00	Thickest layer	0.63
		Thickest layer	0.00	Bottom layer	0.90
110:					
Benally	45	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
Fruitland	40	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.06
		Thickest layer	0.00	Thickest layer	0.10
115:					
Razito	45	Poor		Fair	
		Bottom layer	0.00	Thickest layer	0.10
		Thickest layer	0.00	Bottom layer	0.90
Shiprock	40	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.03
		Thickest layer	0.00	Thickest layer	0.06

Table 9a.--Construction Materials--Continued

Map symbol and soil name	Pct. of map unit	Potential source of gravel		Potential source of sand	
		Rating class	Value	Rating class	Value
116:					
Fajada	35	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
Huerfano	30	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
Benally	20	Poor		Fair	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.06
121:					
Badland	90	Not rated		Not rated	
220:					
Hagerwest	45	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
Bond	40	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
250:					
Hospah	35	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
Skyvillage	30	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
Rock outcrop	25	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
290:					
Rock outcrop	45	Not rated		Not rated	
Westmion	25	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00
Skyvillage	20	Poor		Poor	
		Bottom layer	0.00	Bottom layer	0.00
		Thickest layer	0.00	Thickest layer	0.00

Table 9b.--Construction Materials

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. The numbers in the value columns range from 0.00 to 0.99. The smaller the value, the greater the limitation. See text for further explanation of ratings in this table.)

Map symbol and soil name	Pct. of map unit	Potential source of reclamation material		Potential source of roadfill		Potential source of topsoil	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
2:							
Battlerock	45	Fair		Poor		Good	
		Low content of organic matter	0.12	Low strength	0.00		
		Water erosion	0.99	Shrink-swell	0.51		
Notal	35	Poor		Poor		Poor	
		Too clayey	0.00	Low strength	0.00	Too Clayey	0.00
		Too alkaline	0.00	Shrink-swell	0.21	Sodium content	0.78
		Low content of organic matter	0.18			Salinity	0.88
		Sodium content	0.78				
		Water erosion	0.99				
3:							
Beebe	90	Poor		Good		Poor	
		Too sandy	0.00			Too sandy	0.00
		Low content of organic matter	0.12				
		Water erosion	0.90				
		Droughty	0.99				
4:							
Yelives	40	Fair		Good		Good	
		Low content of organic matter	0.12				
		Water erosion	0.99				
Beebe	45	Fair		Good		Good	
		Low content of organic matter	0.12				
5:							
Farb	45	Poor		Poor		Poor	
		Wind erosion	0.00	Depth to bedrock	0.00	Depth to bedrock	0.00
		Droughty	0.00			Slope	0.84
		Depth to bedrock	0.00				
		Low content of organic matter	0.12				
Rock outcrop	45	Not rated		Not rated		Not rated	

Table 9b.--Construction Materials--Continued

Map symbol and soil name	Pct. of map unit	Potential source of reclamation material		Potential source of roadfill		Potential source of topsoil	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
6:							
Chacoan	50	Poor		Poor		Fair	
		Wind erosion	0.00	Depth to bedrock	0.00	Depth to bedrock	0.71
		Low content of organic matter	0.00				
		Droughty	0.02				
		Depth to bedrock	0.71				
Shiprock	40	Poor		Good		Good	
		Wind erosion	0.00				
		Low content of organic matter	0.12				
7:							
Chacoan	45	Poor		Poor		Fair	
		Droughty	0.00	Depth to bedrock	0.00	Depth to bedrock	0.10
		Depth to bedrock	0.10				
		Low content of organic matter	0.12				
Kimnoli	35	Poor		Poor		Poor	
		Droughty	0.00	Depth to bedrock	0.00	Depth to bedrock	0.00
		Depth to bedrock	0.00				
		Low content of organic matter	0.12				
8:							
Notal	80	Poor		Poor		Poor	
		Too clayey	0.00	Low strength	0.00	Too Clayey	0.00
		Low content of organic matter	0.12	Shrink-swell	0.67	Sodium content	0.78
		Sodium content	0.78				
		Water erosion	0.99				
9:							
Doak	85	Fair		Poor		Fair	
		Low content of organic matter	0.50	Low strength	0.00	Too Clayey	0.54
		Too clayey	0.82	Shrink-swell	0.87		
		Water erosion	0.99				
10:							
Yelives	90	Fair		Good		Good	
		Low content of organic matter	0.12				
		Water erosion	0.99				
12:							
Riverwash	100	Not rated		Not rated		Not rated	

Table 9b.--Construction Materials--Continued

Map symbol and soil name	Pct. of map unit	Potential source of reclamation material		Potential source of roadfill		Potential source of topsoil	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
13:							
Escawetter	95	Poor		Good		Poor	
		Too sandy	0.00			Too sandy	0.00
		Wind erosion	0.00				
		Droughty	0.08				
		Low content of organic matter	0.12				
		Water erosion	0.90				
16:							
Rock outcrop	40	Not rated		Not rated		Not rated	
Persayo	50	Poor		Poor		Poor	
		Droughty	0.00	Depth to bedrock	0.00	Slope	0.00
		Depth to bedrock	0.00	Slope	0.00	Depth to bedrock	0.00
		Low content of organic matter	0.12				
17:							
Razito	95	Poor		Fair		Poor	
		Too sandy	0.00	Slope	0.50	Too sandy	0.00
		Wind erosion	0.00			Slope	0.00
		Low content of organic matter	0.12				
		Droughty	0.42				
110:							
Benally	45	Poor		Poor		Poor	
		Wind erosion	0.00	Low strength	0.00	Sodium content	0.00
		Sodium content	0.00	Depth to bedrock	0.58	Too Clayey	0.48
		Too alkaline	0.00	Shrink-swell	0.78		
		Low content of organic matter	0.12				
		Too clayey	0.82				
Fruitland	40	Poor		Fair		Good	
		Wind erosion	0.00	Shrink-swell	0.99		
		Too alkaline	0.00				
		Low content of organic matter	0.12				
115:							
Razito	45	Poor		Good		Good	
		Wind erosion	0.00				
		Too alkaline	0.00				
		Low content of organic matter	0.12				

Table 9b.--Construction Materials--Continued

Map symbol and soil name	Pct. of map unit	Potential source of reclamation material		Potential source of roadfill		Potential source of topsoil	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
115:							
Shiprock	40	Poor		Good		Good	
		Wind erosion	0.00				
		Low content of organic matter	0.12				
116:							
Fajada	35	Poor		Poor		Poor	
		Sodium content	0.00	Depth to bedrock	0.00	Sodium content	0.00
		Too alkaline	0.00			Depth to bedrock	0.84
		Low content of organic matter	0.12				
		Droughty	0.79				
		Depth to bedrock	0.84				
		Water erosion	0.99				
Huerfano	30	Poor		Poor		Poor	
		Droughty	0.00	Depth to bedrock	0.00	Sodium content	0.00
		Depth to bedrock	0.00	Low strength	0.00	Depth to bedrock	0.00
		Sodium content	0.00			Too Clayey	0.54
		Too alkaline	0.00				
		Low content of organic matter	0.50				
		Too clayey	0.82				
Benally	20	Poor		Good		Poor	
		Sodium content	0.00			Sodium content	0.00
		Low content of organic matter	0.00				
		Too alkaline	0.00				
121:							
Badland	90	Not rated		Not rated		Not rated	
220:							
Hagerwest	45	Fair		Poor		Fair	
		Droughty	0.01	Depth to bedrock	0.00	Depth to bedrock	0.01
		Depth to bedrock	0.01	Shrink-swell	0.87		
		Low content of organic matter	0.12				
Bond	40	Poor		Poor		Poor	
		Droughty	0.00	Depth to bedrock	0.00	Depth to bedrock	0.00
		Depth to bedrock	0.00				
		Low content of organic matter	0.12				

Table 9b.--Construction Materials--Continued

Map symbol and soil name	Pct. of map unit	Potential source of reclamation material		Potential source of roadfill		Potential source of topsoil	
		Rating class and limiting features	Value	Rating class and limiting features	Value	Rating class and limiting features	Value
250:							
Hospah	35	Poor		Poor		Poor	
		Too clayey	0.00	Depth to bedrock	0.00	Too Clayey	0.00
		Droughty	0.00	Low strength	0.00	Depth to bedrock	0.00
		Depth to bedrock	0.00	Shrink-swell	0.12	Slope	0.00
		Low content of organic matter	0.12	Slope	0.50	Sodium content	0.78
		Sodium content	0.78				
Skyvillage	30	Poor		Poor		Poor	
		Droughty	0.00	Depth to bedrock	0.00	Depth to bedrock	0.00
		Depth to bedrock	0.00			Slope	0.84
		Low content of organic matter	0.12				
Rock outcrop	25	Poor		Poor		Poor	
		Low content of organic matter	0.00	Depth to bedrock	0.00	Depth to bedrock	0.00
		Depth to bedrock	0.00	Slope	0.00	Slope	0.00
290:							
Rock outcrop	45	Not rated		Not rated		Not rated	
Westmion	25	Poor		Poor		Poor	
		Too clayey	0.00	Depth to bedrock	0.00	Slope	0.00
		Droughty	0.00	Slope	0.00	Too Clayey	0.00
		Depth to bedrock	0.00			Depth to bedrock	0.00
		Low content of organic matter	0.12				
Skyvillage	20	Poor		Poor		Poor	
		Droughty	0.00	Depth to bedrock	0.00	Depth to bedrock	0.00
		Depth to bedrock	0.00			Rock fragments	0.88
		Low content of organic matter	0.12				

Table 10.--Water Management

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table. Absence of an entry indicates that no rating is applicable.)

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
2:							
Battlerock	Severe: seepage	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: flooding	Favorable	Limitation: too arid
Notal	Slight	Severe: excess salt hard to pack piping	Severe: no water	Limitation: deep to water	Limitation: erodes easily excess salt percs slowly	Limitation: erodes easily percs slowly	Limitation: erodes easily percs slowly too arid
3:							
Beebe	Severe: seepage	Severe: seepage	Severe: slow refill	Limitation: percs slowly	Limitation: flooding	Limitation: erodes easily	Limitation: erodes easily
4:							
Yelives	Severe: seepage	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing	Limitation: soil blowing	Limitation: too arid
Beebe	Severe: seepage	Severe: seepage	Severe: slow refill	Limitation: percs slowly	Limitation: flooding	Limitation: erodes easily	Limitation: erodes easily
5:							
Farb	Severe: slope depth to rock	Severe: thin layer	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing depth to rock	Limitation: slope soil blowing depth to rock	Limitation: slope too arid depth to rock
Rock outcrop	---	---	---	---	---	---	---
6:							
Chacoan	Moderate: seepage slope depth to rock	Severe: thin layer	Severe: no water	Limitation: deep to water	Limitation: fast intake slope soil blowing	Limitation: soil blowing depth to rock	Limitation: too arid depth to rock
Shiprock	Severe: seepage	Severe: excess sodium piping	Severe: no water	Limitation: deep to water	Limitation: fast intake slope soil blowing	Limitation: soil blowing	Limitation: excess sodium too arid
7:							
Chacoan	Moderate: seepage slope depth to rock	Severe: thin layer	Severe: no water	Limitation: deep to water	Limitation: fast intake slope soil blowing	Limitation: soil blowing depth to rock	Limitation: too arid depth to rock

Table 10.--Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
7:							
Kimnoli	Severe: depth to rock	Severe: thin layer	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing depth to rock	Limitation: soil blowing depth to rock	Limitation: too arid depth to rock
8:							
Notal	Slight	Severe: excess salt hard to pack piping	Severe: no water	Limitation: deep to water	Limitation: erodes easily excess salt percs slowly	Limitation: erodes easily percs slowly	Limitation: erodes easily percs slowly too arid
9:							
Doak	Severe: seepage	Moderate: piping thin layer	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing	Limitation: soil blowing	Limitation: too arid
10:							
Yelives	Severe: seepage	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing	Limitation: soil blowing	Limitation: too arid
12:							
Riverwash	---	---	---	---	---	---	---
13:							
Escawetter	Severe: seepage	Severe: seepage	Severe: slow refill	Limitation: percs slowly	Limitation: flooding	Limitation: erodes easily	Limitation: erodes easily
16:							
Rock outcrop	---	---	---	---	---	---	---
Persayo	Severe: slope depth to rock	Severe: thin layer	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing depth to rock	Limitation: slope soil blowing depth to rock	Limitation: slope too arid depth to rock
17:							
Razito	Severe: seepage	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: fast intake slope droughty	Limitation: too sandy soil blowing	Limitation: too arid droughty
110:							
Benally	Moderate: seepage slope	Severe: excess sodium	Severe: no water	Limitation: deep to water	Limitation: excess sodium slope soil blowing	Limitation: soil blowing	Limitation: excess sodium too arid

Table 10.--Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
110:							
Fruitland	Severe: seepage	Severe: excess sodium piping	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing	Limitation: soil blowing	Limitation: excess sodium too arid
115:							
Razito	Severe: seepage	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: fast intake slope droughty	Limitation: too sandy soil blowing	Limitation: too arid droughty
Shiprock	Severe: seepage	Severe: excess sodium piping	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing	Limitation: soil blowing	Limitation: excess sodium too arid
116:							
Fajada	Moderate: slope depth to rock	Severe: excess sodium thin layer excess gypsum	Severe: no water	Limitation: deep to water	Limitation: excess sodium excess gypsum depth to rock	Limitation: excess gypsum depth to rock	Limitation: erodes easily depth to rock droughty
Huerfano	Severe: depth to rock	Severe: excess sodium	Severe: no water	Limitation: deep to water	Limitation: percs slowly slope droughty	Limitation: percs slowly depth to rock	Limitation: excess sodium too arid droughty
Benally	Moderate: depth to rock	Severe: excess sodium	Severe: no water	Limitation: deep to water	Limitation: excess sodium excess salt droughty	Favorable	Limitation: excess sodium too arid droughty
121:							
Badland	---	---	---	---	---	---	---
220:							
Hagerwest	Severe: seepage	Moderate: thin layer	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing depth to rock	Limitation: soil blowing depth to rock	Limitation: too arid depth to rock
Bond	Severe: depth to rock	Severe: thin layer	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing depth to rock	Limitation: soil blowing depth to rock	Limitation: too arid depth to rock

Table 10.--Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
250:							
Hospah	Severe: slope, depth to rock	Severe: thin layer	Severe: no water	Limitation: deep to water	Limitation: percs slowly, slope, depth to rock	Limitation: percs slowly, slope, depth to rock	Limitation: slope, too arid, depth to rock
Skyvillage	Severe: slope, depth to rock	Severe: thin layer	Severe: no water	Limitation: deep to water	Limitation: slope, soil blowing, depth to rock	Limitation: slope, soil blowing, depth to rock	Limitation: slope, too arid, depth to rock
Rock outcrop	---	---	---	---	---	---	---
290:							
Rock outcrop	---	---	---	---	---	---	---
Westmion	Severe: slope, depth to rock	Severe: thin layer	Severe: no water	Limitation: deep to water	Limitation: percs slowly, slope, depth to rock	Limitation: percs slowly, slope, depth to rock	Limitation: slope, too arid, depth to rock
Skyvillage	Severe: slope, depth to rock	Severe: thin layer	Severe: no water	Limitation: deep to water	Limitation: slope, soil blowing, depth to rock	Limitation: slope, soil blowing, depth to rock	Limitation: slope, too arid, depth to rock

Table 11.--Engineering Index Properties

(Absence of an entry indicates that the data were not estimated.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
2:												
Battlerock------	0-3	Fine sandy loam	SC-SM	A-4	0	0	100	100	70-85	35-50	20-30	4-7
	3-7	Clay loam	CL	A-6	0	0	100	100	80-100	70-90	35-40	15-20
	7-11	Stratified clay loam, very fine sand	CL	A-6	0	0	100	100	80-100	70-90	35-40	15-20
	11-17	Stratified loam, very fine sand	CL	A-6	0	0	100	100	80-100	60-80	25-35	10-15
	17-23	Stratified clay loam, very fine sand	CL	A-6	0	0	100	100	80-100	70-90	35-40	15-20
	23-35	Sandy clay loam	CL	A-6	0	0	100	100	65-85	40-60	25-40	10-20
	35-42	Silty clay loam	CL	A-6	0	0	100	100	85-100	80-90	35-50	15-25
	42-65	Silty clay	CH	A-7-6	0	0	100	100	85-100	80-95	50-55	25-30
Notal------	0-2	Clay loam	CL	A-6	0	0	100	100	80-100	70-90	35-40	15-20
	2-7	Clay loam	CL	A-6	0	0	100	100	80-100	70-90	35-40	15-20
	7-14	Clay	CH	A-7-6	0	0	100	100	80-100	75-95	50-60	25-35
	14-19	Clay	CH	A-7-6	0	0	100	100	80-100	75-95	50-60	25-35
	19-26	Silty clay loam	CL	A-7-6	0	0	100	100	85-100	80-90	35-50	15-25
	26-70	Silty clay	CH	A-7-6	0	0	100	100	85-100	80-95	50-55	25-30
3:												
Beebe------	0-5	Silt loam	CL	A-6	0	0	100	100	85-100	75-85	20-35	10-15
	5-12	Stratified fine sandy loam, silt loam	CL-ML	A-4	0	0	100	100	70-85	40-50	20-30	4-7
	12-15	Stratified loam, silt loam	SC-SM	A-6	0	0	100	100	80-100	60-75	25-35	10-15
?	15-20	Fine sand, silt loam	SW-SM	A-3	0	0	100	100	65-80	0-20	0-0	NP
	20-30	Stratified fine sand, silt loam	SW-SM	A-3	0	0	100	100	65-80	0-20	0-0	NP
	30-70	Fine sand	SW-SM	A-3	0	0	100	100	65-80	0-20	0-0	NP
4:												
Yelives------	0-3	Fine sandy loam	CL-ML	A-4	0	0	95-100	85-100	70-85	35-50	20-30	4-7
	3-8	Stratified loam, silt loam	CL, CL-ML	A-6	0	0	95-100	90-100	80-100	60-80	25-35	7-15
	8-28	Stratified fine sandy loam, silt loam	CL-ML	A-4	0	0	95-100	85-100	70-90	50-70	20-30	4-7
	28-42	Loamy fine sand	SM	A-2-4	0	0	95-100	80-90	65-85	20-40	15-20	NP-4
	42-55	Fine sandy loam	CL-ML	A-4	0	0	95-100	85-100	70-85	35-50	20-30	4-7
	55-70	Loamy fine sand	SM	A-2-4	0	0	95-100	80-90	65-85	20-40	15-20	NP-4

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
4:												
Beebe	0-3	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
	3-7	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
	7-16	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
	16-25	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
	25-34	Stratified loamy fine sand, silt loam	SM	A-2-4	0	0	100	95-100	65-85	20-40	15-20	NP-4
	34-52	Stratified sand, silt loam	SW-SM	A-1-b	0	0	100	95-100	40-60	10-15	0-0	NP
	52-56	Silt loam	CL	A-6	0	0	100	95-100	85-100	75-85	20-35	10-15
	56-70	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
5:												
Farb	0-1	Loamy fine sand	SM	A-2-4	0	0	100	90-100	65-85	20-40	15-20	NP-4
	1-5	Loamy fine sand	SM	A-2-4	0	0	100	90-100	65-85	20-40	15-20	NP-4
	5-11	Loamy fine sand	SM	A-2-4	0	0	100	90-100	65-85	20-40	15-20	NP-4
	11-15	Fine sandy loam	SC-SM	A-4	0	0	100	90-100	70-85	35-50	20-30	4-7
	15-20	Unweathered bedrock			---	---	---	---	---	---	---	---
Rock outcrop	0-60	Unweathered bedrock			---	---	---	---	---	---	---	---
6:												
Chacoan	0-2	Loamy fine sand	SM	A-2-4	0	0	100	95-100	65-85	20-40	15-20	NP-4
	2-7	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
	7-12	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
	12-19	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
	19-24	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
	24-32	Weathered bedrock	SC-SM		---	---	---	---	---	---	---	---
	32-40	Unweathered bedrock			---	---	---	---	---	---	---	---
Shiprock	0-2	Loamy fine sand	SM	A-2-4	0	0	100	95-100	65-85	20-40	15-20	NP-4
	2-4	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
	4-21	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
	21-27	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
	27-52	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
	52-62	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
	62-70	Weathered bedrock		A-4	---	---	---	---	---	---	---	---
7:												
Chacoan	0-3	Loamy fine sand	SM	A-2-4	0	0	100	100	65-85	20-40	15-20	NP-4
	3-6	Loamy fine sand	SM	A-2-4	0	0	100	100	65-85	20-40	15-20	NP-4
	6-18	Fine sandy loam	SC-SM	A-4	0	0	100	100	70-85	35-50	20-30	4-7
	18-24	Fine sandy loam	SC-SM	A-4	0	0	100	100	70-85	35-50	20-30	4-7
	24-40	Unweathered bedrock			---	---	---	---	---	---	---	---
Kimnoli	0-3	Loamy fine sand	SM	A-2-4	0	0	100	85-100	70-90	35-50	15-20	NP-4
	3-10	Fine sandy loam	SC-SM	A-4	0	0	100	80-100	70-90	35-50	20-30	4-7
	10-20	Unweathered bedrock			---	---	---	---	---	---	---	---

Table 11.--Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
8:												
Notal	0-3	Silty clay loam	CL	A-6	0	0	100	100	85-100	80-90	35-40	15-20
	3-7	Silty clay	CL	A-6	0	0	100	100	85-100	80-95	35-40	15-20
	7-14	Silty clay	CH	A-7-6	0	0	100	100	85-100	80-95	50-60	25-35
	14-24	Silty clay	CH	A-7-6	0	0	100	100	85-100	80-95	50-60	25-35
	24-58	Silty clay	CL	A-7-6	0	0	100	100	85-100	80-95	35-50	15-25
	58-65	Clay loam	CH	A-7-6	0	0	100	100	80-100	70-90	50-55	25-30
9:												
Doak	0-2	Loam	SC	A-6	0	0	95-100	90-100	80-100	40-50	25-35	10-15
	2-8	Clay loam	CL	A-6	0	0	95-100	90-100	80-100	70-90	35-40	15-20
	8-24	Clay loam	CL	A-6	0	0	95-100	90-100	80-100	70-90	35-40	15-20
	24-31	Clay loam	CL	A-6	0	0	95-100	90-100	80-100	70-90	35-40	15-20
	31-44	Clay loam	CL	A-6	0	0	95-100	90-100	80-100	70-90	35-40	15-20
	44-54	Clay loam	CL	A-6	0	0	95-100	90-100	80-100	70-90	35-40	15-20
	54-60	Clay loam	CL	A-6	0	0	95-100	90-100	80-100	70-90	35-40	15-20
	60-70	Clay loam	CL	A-6	0	0	95-100	90-100	80-100	70-90	35-40	15-20
10:												
Yelives	0-4	Stratified fine sandy loam, silt loam	SC-SM	A-4	0	0	100	85-100	70-90	35-50	20-30	4-7
	4-10	Fine sandy loam	SC-SM	A-4	0	0	100	85-100	70-90	35-50	20-30	4-7
	10-20	Stratified very fine sandy loam, silt loam	SC-SM	A-4	0	0	100	90-100	75-95	35-50	20-30	4-7
	20-34	Stratified loam, silt loam	SC-SM, SC	A-6	0	0	100	100	80-100	40-50	25-35	7-15
	34-46	Fine sand	SW-SM	A-2-4	0	0	100	80-100	65-80	0-20	0-0	NP-4
	46-52	Gravelly coarse sand	SW-SM	A-1	0	0	100	50-70	35-45	0-20	0-0	NP-4
	52-70	Sand	SW-SM	A-2-4	0	0	100	90-100	50-70	0-20	0-0	NP-4
12:												
Riverwash	0-80	Stratified fine sand	SW-SM	A-3	0	0	100	100	20-75	0-20	0-0	NP
13:												
Escawetter	0-6	Stratified fine sand, silt loam	SM, SW-SM	A-2-4	0	0	100	95-100	85-100	0-20	20-35	NP-7
	6-19	Coarse sand	SW-SM	A-1	0	0	100	95-100	40-50	0-20	0-0	NP
	19-38	Coarse sand	SW-SM	A-1	0	0	100	95-100	40-50	0-20	0-0	NP
	38-65	Coarse sand	SW-SM	A-1	0	0	100	95-100	40-50	0-20	0-0	NP
16:												
Rock outcrop	0-60	Unweathered bedrock			---	---	---	---	---	---	---	---
Persayo	0-2	Gravelly fine sandy loam	GC-GM	A-2	0	0	95-100	50-70	30-65	20-30	20-30	4-7
	2-9	Fine sandy loam	SC-SM	A-4	0	0	100	85-100	70-90	35-50	20-30	4-7
	9-23	Weathered bedrock			---	---	---	---	---	---	---	---
	23-33	Unweathered bedrock			---	---	---	---	---	---	---	---

Table 11.--Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
17:												
Razito	0-3	Loamy fine sand	SM	A-2-4	0	0	100	95-100	65-85	20-40	15-20	NP-4
	3-15	Fine sand	SW-SM	A-3	0	0	100	95-100	65-80	0-20	0-0	NP
	15-44	Fine sand	SW-SM	A-3	0	0	100	95-100	65-80	0-20	0-0	NP
	44-70	Fine sand	SW-SM	A-3	0	0	100	95-100	65-80	0-20	0-0	NP
110:												
Benally	0-1	Loamy fine sand	SM	A-2-4	0	0	100	95-100	65-85	20-40	15-20	NP-4
	1-4	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-90	35-50	20-30	4-7
	4-7	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-90	35-50	20-30	4-7
	7-13	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-90	35-50	20-30	4-7
	13-29	Clay loam	CL	A-6	0	0	100	95-100	80-100	70-90	35-40	15-20
	29-40	Sandy clay loam	SC	A-6	0	0	100	95-100	65-85	40-60	25-40	10-20
	40-50	Clay loam	CL	A-6	0	0	100	95-100	80-100	70-90	35-40	15-20
	50-70	Unweathered bedrock			---	---	---	---	---	---	---	---
Fruitland	0-4	Loamy fine sand	SM	A-2-4	0	0	100	90-100	65-85	20-40	15-20	NP-4
	4-20	Loamy fine sand	SM	A-2-4	0	0	100	90-100	65-85	20-40	15-20	NP-4
	20-30	Loamy fine sand	SM	A-2-4	0	0	100	90-100	65-85	20-40	15-20	NP-4
	30-40	Gravelly sandy clay loam	SC	A-6	0	0	100	90-100	65-85	40-60	25-40	7-20
	40-49	Sandy clay loam	SC	A-6	0	0	100	90-100	65-85	40-60	25-40	7-20
	49-58	Fine sandy loam	SC-SM	A-4	0	0	100	90-100	70-90	35-50	20-30	4-7
	58-70	Fine sandy loam	SC-SM	A-4	0	0	100	90-100	70-90	35-50	20-30	4-7
115:												
Razito	0-4	Loamy fine sand	SM	A-2-4	0	0	100	95-100	65-85	20-40	15-20	NP-4
	4-9	Loamy fine sand	SM	A-2-4	0	0	100	95-100	65-85	20-40	15-20	NP-4
	9-20	Loamy fine sand	SM	A-2-4	0	0	100	95-100	65-85	20-40	15-20	NP-4
	20-24	Loamy fine sand	SM	A-2-4	0	0	100	95-100	65-85	20-40	15-20	NP-4
	24-59	Loamy fine sand	SM	A-2-4	0	0	100	95-100	65-85	20-40	15-20	NP-4
	59-70	Fine sand	SW-SM	A-3	0	0	100	95-100	65-80	0-20	0-0	NP
Shiprock	0-2	Loamy fine sand	SM	A-2-4	0	0	100	95-100	65-85	20-40	15-20	NP-4
	2-6	Loamy fine sand	SM	A-2-4	0	0	100	95-100	65-85	20-40	15-20	NP-4
	6-12	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
	12-21	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
	21-39	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
	39-55	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-85	35-50	20-30	4-7
	55-70	Loam	SC	A-6	0	0	100	95-100	80-100	40-50	25-35	10-15
116:												
Fajada	0-3	Fine sandy loam	SC-SM	A-4	0	0	100	90-100	70-90	35-50	20-30	4-7
	3-9	Fine sandy loam	SC-SM	A-4	0	0	100	90-100	70-90	35-50	20-30	4-7
	9-12	Sandy clay loam	SC	A-6	0	0	100	90-100	65-85	40-60	25-40	10-20
	12-17	Fine sandy loam	SC-SM	A-4	0	0	100	90-100	70-90	35-50	20-30	4-7
	17-28	Fine sandy loam	SC-SM	A-4	0	0	100	90-100	70-90	35-50	20-30	4-7
	28-34	Loam	SC	A-6	0	0	100	90-100	80-100	40-50	25-35	10-15
	34-40	Unweathered bedrock			---	---	---	---	---	---	---	---
Huerfano	0-4	Clay loam	CL	A-6	0	0	100	85-100	80-100	70-90	35-40	15-20
	4-20	Unweathered bedrock			---	---	---	---	---	---	---	---

Table 11.--Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
116:												
Benally	0-3	Clay loam	CL	A-6	0	0	100	95-100	80-100	70-90	35-40	15-20
	3-8	Clay loam	CL	A-6	0	0	100	95-100	80-100	70-90	35-40	15-20
	8-13	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-90	35-50	20-30	4-7
	13-29	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-90	35-50	20-30	4-7
	29-54	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-90	35-50	20-30	4-7
	54-62	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-90	35-50	20-30	4-7
	62-65	Unweathered bedrock			---	---	---	---	---	---	---	---
	65-70	Unweathered bedrock			---	---	---	---	---	---	---	---
121:												
Badland	0-2	Weathered bedrock			0	0	100	100	100	90-100	55-65	25-35
	2-10	Unweathered bedrock			---	---	---	---	---	---	---	---
220:												
Hagerwest	0-2	Fine sandy loam	SC-SM	A-4	0	0	100	85-100	70-90	40-55	20-30	4-7
	2-7	Sandy clay loam	SC	A-6	0	0	100	85-100	65-85	40-60	25-40	10-20
	7-13	Sandy clay loam	SC	A-6	0	0	100	85-100	65-85	40-60	25-40	10-20
	13-21	Sandy clay loam	SC	A-4	0	0	100	85-100	65-85	40-60	25-40	7-10
	21-40	Unweathered bedrock			---	---	---	---	---	---	---	---
Bond	0-3	Fine sandy loam	SC-SM	A-4	0	0	100	95-100	70-90	35-50	20-30	4-7
	3-10	Fine sandy loam	SC-SM	A-4	0	0	100	90-100	70-90	35-50	20-30	4-7
	10-15	Fine sandy loam	SC-SM	A-4	0	0	100	90-100	70-90	35-50	20-30	4-7
	15-20	Unweathered bedrock			---	---	---	---	---	---	---	---
250:												
Hospah	0-3	Clay loam	CL	A-6	0	0-5	95-100	90-100	80-100	70-90	35-40	15-20
	3-15	Clay	CL	A-7-6	0	0-5	95-100	90-100	80-100	75-95	40-50	25-35
	15-20	Unweathered bedrock			---	---	---	---	---	---	---	---
Skyvillage	0-1	Gravelly loamy fine sand	SM	A-2-4	0	0	95-100	50-70	25-35	15-35	10-20	NP-4
	1-7	Fine sandy loam	SC-SM	A-4	0	0	100	90-100	70-90	35-50	20-30	4-7
	7-20	Unweathered bedrock			---	---	---	---	---	---	---	---
Rock outcrop	0-60	Unweathered bedrock			---	---	---	---	---	---	---	---

Table 11.--Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
290:												
Rock outcrop----	0-60	Unweathered bedrock			---	---	---	---	---	---	---	---
Westmion--------	0-2	Gravelly clay loam	GC	A-6, A-7-6	0	0	20-55	15-50	10-40	10-35	40-50	15-20
	2-8	Clay	CL	A-7-6	0	0	100	80-100	80-100	75-95	40-50	25-35
	8-20	Unweathered bedrock			---	---	---	---	---	---	---	---
Skyvillage------	0-3	Extremely gravelly sandy loam	GC-GM	A-1-b, A-2-4	0	0	20-55	15-50	10-40	5-35	15-25	4-7
	3-11	Gravelly sandy loam	GC-GM, SM	A-2-4, A-4	0	0	50-85	15-75	25-65	15-30	15-25	NP-7
	11-20	Unweathered bedrock			---	---	---	---	---	---	---	---

Table 12.--Physical Properties of the Soils

(Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Wind erodibility index" apply only to the surface layer. Absence of an entry indicates that data were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability (Ksat)	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
								Kw	Kf	T		
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
2:												
Battlerock	0-3	10-15	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.5-1.0	.28	.28	5	3	86
	3-7	27-35	1.35-1.45	0.20-0.60	0.19-0.21	6.0-8.9	0.5-1.0	.32	.32			
	7-11	27-35	1.35-1.45	0.20-0.60	0.19-0.21	6.0-8.9	0.0-0.5	.32	.32			
	11-17	15-27	1.35-1.45	0.60-2.00	0.16-0.18	3.0-5.9	0.0-0.5	.37	.37			
	17-23	27-35	1.35-1.45	0.20-0.60	0.19-0.21	6.0-8.9	0.0-0.5	.32	.32			
	23-35	20-35	1.35-1.45	0.60-2.00	0.14-0.16	3.0-5.9	0.0-0.5	.32	.32			
	35-42	27-35	1.25-1.35	0.20-0.60	0.19-0.21	3.0-5.9	0.0-0.5	.37	.37			
	42-70	40-50	1.25-1.35	0.06-0.20	0.15-0.17	6.0-8.9	0.0-0.5	.24	.24			
Notal	0-2	27-35	1.35-1.45	0.20-0.60	0.19-0.21	3.0-5.9	0.5-1.0	.32	.32	5	6	48
	2-7	27-35	1.35-1.45	0.20-0.60	0.19-0.21	3.0-5.9	0.5-1.0	.32	.32			
	7-14	40-60	1.25-1.35	0.06-0.20	0.14-0.16	6.0-8.9	0.0-0.5	.20	.20			
	14-19	40-60	1.25-1.35	0.06-0.20	0.14-0.16	6.0-8.9	0.0-0.5	.20	.20			
	19-26	27-35	1.25-1.35	0.20-0.60	0.19-0.21	3.0-5.9	0.0-0.5	.37	.37			
	26-70	40-60	1.25-1.35	0.06-0.20	0.15-0.17	6.0-8.9	0.0-0.5	.24	.24			
3:												
Beebe	0-5	10-15	1.25-1.35	0.60-2.00	0.19-0.21	0.0-2.9	0.5-1.0	.43	.43	5	4L	86
	5-12	5-15	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	12-15	7-15	1.35-1.45	0.60-2.00	0.16-0.18	0.0-2.9	0.0-0.5	.37	.37			
	15-20	0-5	1.65-1.75	6.00-20.00	0.05-0.07	0.0-2.9	0.0-0.5	.17	.17			
	20-30	0-5	1.65-1.75	6.00-20.00	0.05-0.07	0.0-2.9	0.0-0.5	.17	.17			
	30-70	0-5	1.65-1.75	6.00-20.00	0.05-0.07	0.0-2.9	0.0-0.5	.17	.17			
4:												
Yelives	0-3	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.5-1.0	.28	.28	5	3	86
	3-8	7-18	1.35-1.45	0.60-2.00	0.16-0.18	3.0-5.9	0.5-1.0	.37	.37			
	8-28	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	28-42	2-8	1.55-1.65	6.00-20.00	0.09-0.10	0.0-2.9	0.0-0.5	.20	.20			
	42-55	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	55-70	2-8	1.55-1.65	6.00-20.00	0.09-0.10	0.0-2.9	0.0-0.5	.20	.20			
Beebe	0-3	5-15	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.5-1.0	.28	.28	5	3	86
	3-7	5-15	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.5-1.0	.28	.28			
	7-16	5-15	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.5-1.0	.28	.28			
	16-25	5-15	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	25-34	5-10	1.55-1.65	6.00-20.00	0.09-0.10	0.0-2.9	0.0-0.5	.20	.20			
	34-52	0-5	1.65-1.75	6.00-20.00	0.07-0.09	0.0-2.9	0.0-0.5	.10	.10			
	52-56	5-15	1.25-1.35	0.60-2.00	0.19-0.21	0.0-2.9	0.0-0.5	.43	.43			
	56-70	5-15	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
5:												
Farb	0-1	2-8	1.45-1.55	6.00-20.00	0.09-0.10	0.0-2.9	0.0-0.5	.20	.20	1	2	134
	1-5	2-8	1.45-1.55	6.00-20.00	0.09-0.10	0.0-2.9	0.0-0.5	.20	.20			
	5-11	2-8	1.45-1.55	6.00-20.00	0.09-0.10	0.0-2.9	0.0-0.5	.20	.20			
	11-15	7-20	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	15-20	---	---	0.20-2.00	---	---	---	---	---			
Rock outcrop	0-60	---	---	0.00-0.06	---	---	---	---	---	-	---	---

Table 12.--Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability (Ksat)	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
								Kw	Kf	T		
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
6:												
Chacoan	0-2	2-8	1.55-1.75	6.00-20.00	0.09-0.10	0.0-2.9	0.5-1.0	.20	.20	2	2	134
	2-7	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	7-12	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	12-19	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	19-24	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	24-32	---	---	0.20-2.00	---	---	---	---	---			
	32-40	---	---	0.00-2.00	---	---	---	---	---			
Shiprock	0-2	2-8	1.55-1.75	6.00-20.00	0.09-0.10	0.0-2.9	0.5-1.0	.20	.20	5	2	134
	2-4	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	4-21	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	21-27	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	27-52	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	52-62	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	62-70	---	---	0.20-2.00	---	---	---	---	---			
7:												
Chacoan	0-3	2-8	1.55-1.75	6.00-20.00	0.09-0.10	0.0-2.9	0.5-1.0	.20	.20	2	3	86
	3-6	2-8	1.55-1.75	6.00-20.00	0.09-0.10	0.0-2.9	0.0-0.5	.20	.20			
	6-18	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	18-24	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	24-40	---	---	0.00-2.00	---	---	---	---	---			
Kimnoli	0-3	2-8	1.55-1.65	6.00-20.00	0.09-0.11	0.0-2.9	0.5-1.0	.20	.20	1	3	86
	3-10	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	10-20	---	---	0.00-2.00	---	---	---	---	---			
8:												
Notal	0-3	27-40	1.25-1.35	0.20-0.60	0.19-0.21	3.0-5.9	0.5-1.0	.32	.32	5	4L	86
	3-7	40-60	1.25-1.35	0.06-0.20	0.15-0.17	3.0-5.9	0.5-1.0	.32	.32			
	7-14	40-60	1.25-1.35	0.06-0.20	0.15-0.17	6.0-8.9	0.0-0.5	.20	.20			
	14-24	40-60	1.25-1.35	0.06-0.20	0.15-0.17	6.0-8.9	0.0-0.5	.20	.20			
	24-58	40-60	1.25-1.35	0.06-0.20	0.15-0.17	3.0-5.9	0.0-0.5	.37	.37			
	58-65	27-40	1.35-1.45	0.20-0.60	0.19-0.21	6.0-8.9	0.0-0.5	.24	.24			
9:												
Doak	0-2	7-27	1.35-1.45	0.60-2.00	0.16-0.18	3.0-5.9	0.5-1.0	.37	.37	5	5	56
	2-8	27-40	1.35-1.45	0.20-0.60	0.19-0.21	3.0-5.9	0.5-1.0	.32	.32			
	8-24	27-40	1.35-1.45	0.20-0.60	0.19-0.21	3.0-5.9	0.0-0.5	.32	.32			
	24-31	27-40	1.35-1.45	0.20-0.60	0.19-0.21	3.0-5.9	0.0-0.5	.32	.32			
	31-44	27-40	1.35-1.45	0.20-0.60	0.19-0.21	3.0-5.9	0.0-0.5	.32	.32			
	44-54	27-40	1.35-1.45	0.20-0.60	0.19-0.21	3.0-5.9	0.0-0.5	.32	.32			
	54-60	27-40	1.35-1.45	0.20-0.60	0.19-0.21	3.0-5.9	0.0-0.5	.32	.32			
	60-70	27-40	1.35-1.45	0.20-0.60	0.19-0.21	3.0-5.9	0.0-0.5	.32	.32			
10:												
Yelives	0-4	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.5-1.0	.28	.28	5	3	86
	4-10	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.5-1.0	.28	.28			
	10-20	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	20-34	7-27	1.35-1.45	0.60-2.00	0.16-0.18	0.0-2.9	0.0-0.5	.37	.37			
	34-46	0-5	1.65-1.75	6.00-20.00	0.05-0.07	0.0-2.9	0.0-0.5	.17	.17			
	46-52	0-5	1.65-1.75	6.00-20.00	0.03-0.05	0.0-2.9	0.0-0.5	.05	.10			
	52-70	0-5	1.65-1.75	6.00-20.00	0.03-0.05	0.0-2.9	0.0-0.5	.10	.10			

Table 12.--Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability (Ksat)	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
								Kw	Kf	T		
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
12:												
Riverwash	0-80	0-5	1.55-1.65	6.00-20.00	0.00-0.02	0.0-2.9	0.0-0.0	.17	.17	5	1	310
13:												
Escawetter	0-6	5-15	1.55-1.65	0.60-2.00	0.19-0.21	3.0-5.9	0.5-1.0	.43	.43	5	1	---
	6-19	0-5	1.65-1.75	6.00-20.00	0.03-0.05	0.0-2.9	0.0-0.5	.10	.10			
	19-38	0-5	1.65-1.75	6.00-20.00	0.03-0.05	0.0-2.9	0.0-0.5	.10	.10			
	38-65	0-5	1.65-1.75	6.00-20.00	0.03-0.05	0.0-2.9	0.0-0.5	.10	.10			
16:												
Rock outcrop	0-60	---	---	0.00-0.06	---	---	---	---	---	-	---	---
Persayo	0-2	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.5-1.0	.15	.28	1	3	86
	2-9	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	9-23	---	---	0.00-0.60	---	---	---	---	---			
	23-33	---	---	0.00-2.00	---	---	---	---	---			
17:												
Razito	0-3	2-8	1.55-1.65	6.00-20.00	0.09-0.10	0.0-2.9	0.5-1.0	.20	.20	5	2	134
	3-15	0-5	1.65-1.75	6.00-20.00	0.05-0.07	0.0-2.9	0.0-0.5	.17	.17			
	15-44	0-5	1.65-1.75	6.00-20.00	0.05-0.07	0.0-2.9	0.0-0.5	.17	.17			
	44-70	0-5	1.65-1.75	6.00-20.00	0.05-0.07	0.0-2.9	0.0-0.5	.17	.17			
110:												
Benally	0-1	2-8	1.55-1.65	6.00-20.00	0.09-0.10	0.0-2.9	0.5-1.0	.20	.20	4	2	134
	1-4	7-20	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.5-1.0	.28	.28			
	4-7	7-20	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	7-13	7-20	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	13-29	27-40	1.35-1.45	0.20-0.60	0.19-0.21	3.0-5.9	0.0-0.5	.32	.32			
	29-40	20-35	1.35-1.45	0.60-2.00	0.14-0.16	3.0-5.9	0.0-0.5	.32	.32			
	40-50	27-40	1.35-1.45	0.20-0.60	0.19-0.21	6.0-8.9	0.0-0.5	.32	.32			
	50-70	---	---	0.00-0.60	---	---	---	---	---			
Fruitland	0-4	2-8	1.55-1.65	6.00-20.00	0.09-0.10	0.0-2.9	0.5-1.0	.20	.20	5	2	134
	4-20	2-8	1.55-1.65	6.00-20.00	0.09-0.10	0.0-2.9	0.0-0.5	.20	.20			
	20-30	2-8	1.55-1.65	6.00-20.00	0.09-0.10	0.0-2.9	0.0-0.5	.20	.20			
	30-40	20-35	1.35-1.45	0.60-2.00	0.14-0.16	3.0-5.9	0.0-0.5	.15	.15			
	40-49	20-35	1.35-1.45	0.60-2.00	0.14-0.16	3.0-5.9	0.0-0.5	.32	.32			
	49-58	7-20	1.45-1.55	2.00-6.00	0.13-0.15	3.0-5.9	0.0-0.5	.28	.28			
	58-70	7-20	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
115:												
Razito	0-4	0-5	1.55-1.65	6.00-20.00	0.09-0.10	0.0-2.9	0.0-0.5	.20	.20	5	2	134
	4-9	0-5	1.55-1.65	6.00-20.00	0.09-0.10	0.0-2.9	0.0-0.5	.20	.20			
	9-20	0-5	1.55-1.65	6.00-20.00	0.09-0.10	0.0-2.9	0.0-0.5	.20	.20			
	20-24	0-5	1.55-1.65	6.00-20.00	0.09-0.10	0.0-2.9	0.0-0.5	.20	.20			
	24-59	0-5	1.55-1.65	6.00-20.00	0.09-0.10	0.0-2.9	0.0-0.5	.20	.20			
	59-70	0-5	1.65-1.75	6.00-20.00	0.05-0.07	0.0-2.9	0.0-0.5	.17	.17			

Table 12.--Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability (Ksat)	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
								Kw	Kf	T		
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
115:												
Shiprock	0-2	2-8	1.55-1.65	6.00-20.00	0.09-0.10	0.0-2.9	0.5-1.0	.20	.20	5	2	134
	2-6	2-8	1.55-1.65	6.00-20.00	0.09-0.10	0.0-2.9	0.0-0.5	.20	.20			
	6-12	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	12-21	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	21-39	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	39-55	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	55-70	7-27	1.35-1.45	0.60-2.00	0.16-0.18	3.0-5.9	0.0-0.5	.37	.37			
116:												
Fajada	0-3	7-20	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.5-1.0	.28	.28	3	3	86
	3-9	7-20	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	9-12	20-35	1.35-1.45	0.60-2.00	0.14-0.16	0.0-2.9	0.0-0.5	.32	.32			
	12-17	7-20	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	17-28	7-20	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	28-34	7-27	1.35-1.45	0.60-2.00	0.16-0.18	3.0-5.9	0.0-0.5	.37	.37			
	34-40	---	---	0.00-0.60	---	---	---	---	---			
Huerfano	0-4	27-40	1.35-1.45	0.20-0.60	0.19-0.21	3.0-5.9	0.0-1.0	.32	.32	1	4L	86
	4-20	---	---	0.00-0.60	---	---	---	---	---			
Benally	0-3	27-40	1.35-1.45	0.20-0.60	0.19-0.21	3.0-5.9	0.0-1.0	.32	.32	5	3	86
	3-8	27-40	1.35-1.45	0.20-0.60	0.19-0.21	3.0-5.9	0.0-1.0	.32	.32			
	8-13	7-20	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	13-29	7-20	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	29-54	7-20	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	54-62	7-20	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	62-65	---	---	0.00-0.60	---	---	---	---	---			
	65-70	---	---	0.00-0.60	---	---	---	---	---			
121:												
Badland	0-2	50-60	1.15-1.25	0.00-0.06	0.00-0.12	6.0-8.9	0.0-0.0	.20	.20	1	4	86
	2-10	---	---	0.00-0.06	---	---	---	---	---			
220:												
Hagerwest	0-2	7-20	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.5-1.0	.28	.28	2	3	86
	2-7	20-35	1.35-1.45	0.60-2.00	0.14-0.16	3.0-5.9	0.0-0.5	.32	.32			
	7-13	20-35	1.35-1.45	0.60-2.00	0.14-0.16	3.0-5.9	0.0-0.5	.32	.32			
	13-21	20-35	1.35-1.45	0.60-2.00	0.14-0.16	3.0-5.9	0.0-0.5	.32	.32			
	21-40	---	---	0.00-2.00	---	---	---	---	---			
Bond	0-3	7-20	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.5-1.0	.28	.28	1	3	86
	3-10	7-20	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	10-15	7-20	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	15-20	---	---	0.00-2.00	---	---	---	---	---			
250:												
Hospah	0-3	27-40	1.35-1.45	0.20-0.60	0.19-0.21	3.0-5.9	0.5-1.0	.32	.32	2	4L	86
	3-15	40-60	1.25-1.35	0.06-0.20	0.14-0.16	6.0-8.9	0.0-0.5	.20	.20			
	15-20	---	---	0.00-0.60	---	---	---	---	---			

Table 12.--Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability (Ksat)	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
								Kw	Kf	T		
	In	Pct	g/cc	In/hr	In/in	Pct	Pct					
250:												
Skyvillage	0-1	2-8	1.55-1.65	6.00-20.00	0.09-0.10	0.0-2.9	0.5-1.0	.10	.10	1	3	86
	1-7	7-18	1.45-1.55	2.00-6.00	0.13-0.15	0.0-2.9	0.0-0.5	.28	.28			
	7-20	---	---	0.00-2.00	---	---	---	---	---			
Rock outcrop	0-60	---	---	0.00-0.06	---	---	---	---	---	-	---	---
290:												
Rock outcrop	0-60	---	---	0.00-0.06	---	---	---	---	---	-	---	---
Westmion	0-2	27-40	1.35-1.45	0.20-0.60	0.19-0.21	6.0-8.9	0.5-1.0	.15	.15	1	6	48
	2-8	40-60	1.25-1.35	0.06-0.20	0.14-0.16	6.0-8.9	0.0-0.5	.20	.20			
	8-20	---	---	0.00-0.60	---	---	---	---	---			
Skyvillage	0-3	7-18	1.45-1.55	2.00-6.00	0.11-0.13	0.0-2.9	0.5-1.0	.15	.15	1	3	86
	3-11	7-18	1.45-1.55	2.00-6.00	0.11-0.13	0.0-2.9	0.0-0.5	.15	.15			
	11-20	---	---	0.00-2.00	---	---	---	---	---			

Table 13.--Chemical Properties of the Soils

(Absence of an entry indicates that data were not estimated.)

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	In	meq/100 g	pH	Pct	Pct	mmhos/cm	
2:							
Battlerock	0-3	5.0-15	7.4-7.8	0-2	0-1	0.0-4.0	0-5
	3-7	15-25	7.9-8.4	0-5	0-1	0.0-4.0	0-5
	7-11	15-25	7.9-8.4	0-5	0-5	0.0-4.0	0-5
	11-17	10-20	7.9-8.4	0-5	0-5	0.0-4.0	0-5
	17-23	15-25	7.9-8.4	0-5	0-5	0.0-4.0	0-5
	23-35	10-25	7.9-8.4	0-5	0-5	0.0-4.0	0-5
	35-42	15-25	7.9-8.4	0-5	0-5	0.0-4.0	0-5
	42-70	15-25	7.9-8.4	0-5	0-5	0.0-4.0	0-5
Notal	0-2	15-25	7.4-7.8	0-2	0-1	0.0-4.0	5-10
	2-7	15-25	7.9-8.4	0-5	0-5	0.0-4.0	5-10
	7-14	15-35	8.5-9.0	0-5	0-5	0.0-4.0	5-10
	14-19	15-35	8.5-9.0	0-5	0-5	0.0-4.0	5-10
	19-26	15-25	8.5-9.0	0-5	0-5	2.0-8.0	5-10
	26-70	15-25	7.9-8.4	0-5	0-5	2.0-8.0	5-10
3:							
Beebe	0-5	10-20	7.9-8.4	0-5	0-1	0.0-2.0	0-2
	5-12	5.0-15	7.9-8.4	0-5	0-1	0.0-2.0	0-2
	12-15	10-20	7.9-8.4	0-5	0-1	0.0-2.0	0-2
	15-20	0.0-5.0	7.4-7.8	0-5	0-1	0.0-2.0	0-2
	20-30	0.0-5.0	7.4-7.8	0-5	0-1	0.0-2.0	0-2
	30-70	0.0-5.0	7.4-7.8	0-5	0-1	0.0-2.0	0-2
4:							
Yelives	0-3	5.0-15	7.4-7.8	0-5	0-1	0.0-2.0	0-2
	3-8	10-20	7.9-8.4	0-5	0-1	0.0-2.0	0-2
	8-28	5.0-15	7.9-8.4	0-5	0-1	0.0-2.0	0-5
	28-42	0.0-5.0	7.9-8.4	0-5	0-1	0.0-2.0	0-5
	42-55	5.0-15	7.9-8.4	0-5	0-1	0.0-2.0	0-5
	55-70	0.0-5.0	7.9-8.4	0-5	0-1	0.0-2.0	0-5
Beebe	0-3	5.0-15	7.4-7.8	0-5	0-1	0.0-2.0	0-2
	3-7	5.0-15	7.9-8.4	0-5	0-1	0.0-2.0	0-2
	7-16	5.0-15	7.9-8.4	0-5	0-1	0.0-2.0	0-2
	16-25	5.0-15	7.9-8.4	0-5	0-1	0.0-2.0	0-2
	25-34	0.0-5.0	7.4-7.8	0-5	0-1	0.0-2.0	0-2
	34-52	0.0-5.0	7.4-7.8	0-5	0-1	0.0-2.0	0-2
	52-56	10-20	7.4-7.8	0-5	0-1	0.0-2.0	0-2
	56-70	5.0-15	7.9-8.4	0-5	0-1	0.0-2.0	0-2
5:							
Farb	0-1	0.0-5.0	7.4-7.8	1-5	0	0	0
	1-5	0.0-5.0	7.4-7.8	1-5	0	0	0
	5-11	0.0-5.0	7.9-8.4	1-5	0	0	0
	11-15	5.0-15	7.9-8.4	1-5	0	0	0
	15-20	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---

Table 13.--Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	In	meq/100 g	pH	Pct	Pct	mmhos/cm	
6:							
Chacoan	0-2	0.0-5.0	7.4-7.8	0	0	0.0-2.0	0
	2-7	5.0-15	7.4-7.8	0-5	0	0.0-2.0	0
	7-12	5.0-15	7.4-7.8	0-5	0	0.0-2.0	0
	12-19	5.0-15	7.9-8.4	0-5	0	0.0-2.0	0
	19-24	5.0-15	7.9-8.4	0-5	0	0.0-2.0	0
	24-32	---	---	---	---	---	---
	32-40	---	---	---	---	---	---
Shiprock	0-2	0.0-5.0	7.4-7.8	0	0	0.0-2.0	0
	2-4	5.0-15	7.4-7.8	0	0	0.0-2.0	0
	4-21	5.0-15	7.4-7.8	0	0	0.0-2.0	0
	21-27	5.0-15	7.4-7.8	0-15	0	0.0-2.0	0
	27-52	5.0-15	7.9-8.4	0-15	0	0.0-2.0	0-2
	52-62	5.0-15	7.9-8.4	0-15	0	0.0-2.0	0-2
	62-70	---	---	---	---	---	---
7:							
Chacoan	0-3	0.0-5.0	7.4-7.8	0	0	0.0-2.0	0
	3-6	0.0-5.0	7.4-7.8	0	0	0.0-2.0	0
	6-18	5.0-15	7.4-7.8	0-5	0	0.0-2.0	0
	18-24	5.0-15	7.9-8.4	0-5	0	0.0-2.0	0
	24-40	---	---	---	---	---	---
Kimnoli	0-3	0.0-5.0	7.9-8.4	0-5	0	0.0-2.0	0
	3-10	5.0-15	7.9-8.4	0-5	0	0.0-2.0	0
	10-20	---	---	---	---	---	---
8:							
Notal	0-3	15-25	7.4-7.8	0-2	0-1	0.0-4.0	5-10
	3-7	15-25	7.9-8.4	0-5	0-5	0.0-4.0	5-10
	7-14	15-25	7.9-9.0	0-5	0-5	0.0-4.0	5-10
	14-24	15-25	7.9-9.0	0-5	0-5	0.0-4.0	5-10
	24-58	15-25	7.9-9.0	0-5	0-5	0.0-4.0	5-10
	58-65	15-25	7.9-8.4	0-5	0-5	2.0-8.0	5-30
9:							
Doak	0-2	10-20	7.4-7.8	0-1	0-1	0.0-2.0	0-2
	2-8	15-25	7.4-7.8	0-5	0-1	0.0-2.0	0-2
	8-24	15-25	7.4-7.8	0-5	0-1	0.0-2.0	0-2
	24-31	15-25	7.4-7.8	0-5	0-1	0.0-2.0	0-2
	31-44	15-25	7.4-7.8	0-5	0-1	0.0-2.0	0-2
	44-54	15-25	7.4-7.8	0-5	0-1	0.0-2.0	0-2
	54-60	15-25	7.9-8.4	0-5	0-1	0.0-2.0	0-2
	60-70	15-25	7.9-8.4	0-5	0-1	0.0-2.0	0-2
10:							
Yelives	0-4	5.0-15	7.9-8.4	0-5	0-1	0.0-2.0	0-2
	4-10	5.0-15	7.9-8.4	0-5	0-1	0.0-2.0	0-2
	10-20	5.0-15	7.9-8.4	0-5	0-1	0.0-2.0	0-2
	20-34	10-20	7.9-8.4	0-5	0-1	0.0-2.0	0-2
	34-46	0.0-5.0	7.9-8.4	0-5	0-1	0.0-2.0	0-2
	46-52	0.0-5.0	7.9-8.4	0-5	0-1	0.0-2.0	0-2
	52-70	0.0-5.0	7.9-8.4	0-5	0-1	0.0-2.0	0-2

Table 13.--Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	In	meq/100 g	pH	Pct	Pct	mmhos/cm	
12:							
Riverwash	0-80	0.0-0.0	7.9-8.4	0-1	0-1	0.0-2.0	0-1
13:							
Escawetter	0-6	10-20	7.9-8.4	0-2	0-1	0.0-4.0	0-2
	6-19	0.0-5.0	7.4-7.8	0-2	0-1	0.0-4.0	0-2
	19-38	0.0-5.0	7.4-7.8	0-2	0-1	0.0-4.0	0-2
	38-65	0.0-5.0	7.4-7.8	0-2	0-1	0.0-4.0	0-2
16:							
Rock outcrop	0-60	---	---	---	---	---	---
Persayo	0-2	5.0-15	7.4-7.8	0-5	0-1	0.0-2.0	0-2
	2-9	5.0-15	7.4-7.8	0-5	0-1	0.0-2.0	0-2
	9-23	---	---	---	---	---	---
	23-33	---	---	---	---	---	---
17:							
Razito	0-3	0.0-5.0	7.4-7.8	0	0	0.0-2.0	0-2
	3-15	0.0-5.0	7.9-8.4	0-5	0	0.0-2.0	0-2
	15-44	0.0-5.0	7.9-8.4	0-5	0	0.0-2.0	0-2
	44-70	0.0-5.0	7.9-8.4	0-5	0	0.0-2.0	0-2
110:							
Benally	0-1	0.0-5.0	7.9-9.6	1-10	0-5	0.0-4.0	13-30
	1-4	5.0-15	8.5-9.6	1-10	0-5	0.0-4.0	13-30
	4-7	5.0-15	8.5-9.6	1-10	0-5	0.0-4.0	13-30
	7-13	5.0-15	8.5-9.6	1-10	0-5	0.0-4.0	13-30
	13-29	15-25	8.5-9.6	1-10	0-5	0.0-4.0	13-30
	29-40	10-25	8.5-9.0	1-10	0-5	0.0-4.0	13-30
	40-50	15-25	8.5-9.0	1-10	0-5	0.0-4.0	13-30
	50-70	---	---	---	---	---	---
Fruitland	0-4	0.0-5.0	7.4-7.8	0-5	0-1	0.0-2.0	0-2
	4-20	0.0-5.0	7.9-8.4	0-5	0-1	0.0-2.0	0-2
	20-30	0.0-5.0	7.9-8.4	0-5	0-1	0.0-2.0	0-2
	30-40	10-25	8.5-9.0	1-10	0-1	0.0-2.0	0-5
	40-49	10-25	8.5-9.0	1-10	0-1	0.0-2.0	0-5
	49-58	5.0-15	7.9-8.4	1-10	0-1	0.0-2.0	0-5
	58-70	5.0-15	7.9-8.4	1-10	0-1	0.0-2.0	0-5
115:							
Razito	0-4	0.0-5.0	7.9-8.4	0-5	0	0.0-2.0	0-2
	4-9	0.0-5.0	7.9-8.4	0-5	0	0.0-2.0	0-2
	9-20	0.0-5.0	7.9-8.4	0-5	0	0.0-2.0	0-2
	20-24	0.0-5.0	7.9-8.4	0-5	0	0.0-2.0	0-2
	24-59	0.0-5.0	8.5-9.0	0-5	0	0.0-2.0	0-2
	59-70	0.0-5.0	7.9-8.4	0-5	0	0.0-2.0	0-2

Table 13.--Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	In	meq/100 g	pH	Pct	Pct	mmhos/cm	
115:							
Shiprock	0-2	0.0-5.0	7.4-7.8	0	0	0.0-2.0	0-2
	2-6	0.0-5.0	7.4-7.8	0	0	0.0-2.0	0-2
	6-12	5.0-15	7.4-7.8	0	0	0.0-2.0	0-2
	12-21	5.0-15	7.4-7.8	0-15	0	0.0-2.0	0-2
	21-39	5.0-15	7.4-8.4	0-15	0	0.0-2.0	0-2
	39-55	5.0-15	7.4-8.4	0-15	0	0.0-2.0	0-2
	55-70	10-20	7.4-8.4	0-15	0	0.0-2.0	0-2
116:							
Fajada	0-3	5.0-15	7.9-8.4	1-10	0-2	0.0-4.0	13-30
	3-9	5.0-15	8.5-9.6	1-10	0-2	0.0-4.0	13-30
	9-12	10-25	8.5-9.6	1-10	0-2	0.0-4.0	13-30
	12-17	5.0-15	8.5-9.6	1-10	0-2	0.0-4.0	13-30
	17-28	5.0-15	8.5-9.6	1-10	0-2	0.0-4.0	13-30
	28-34	10-20	8.5-9.6	1-10	0-2	0.0-4.0	13-30
	34-40	---	---	---	---	---	---
Huerfano	0-4	15-25	8.5-9.6	1-10	0-2	0.0-4.0	13-30
	4-20	---	---	---	---	---	---
Benally	0-3	15-25	7.9-9.6	1-10	0-2	0.0-4.0	13-30
	3-8	15-25	8.5-9.6	1-10	0-2	0.0-4.0	13-30
	8-13	5.0-15	8.5-9.6	1-10	0-2	0.0-4.0	13-30
	13-29	5.0-15	8.5-9.6	1-10	0-2	0.0-4.0	13-30
	29-54	5.0-15	8.5-9.6	1-10	0-2	0.0-4.0	13-30
	54-62	5.0-15	8.5-9.6	1-10	0-2	0.0-4.0	13-30
	62-65	---	---	---	---	---	---
	65-70	---	---	---	---	---	---
121:							
Badland	0-2	15-25	6.0-9.0	0-5	1-5	2.0-4.0	1-13
	2-10	---	---	---	---	---	---
220:							
Hagerwest	0-2	5.0-15	7.4-7.8	0	0	0.0-2.0	0
	2-7	10-25	7.4-7.8	0	0	0.0-2.0	0
	7-13	10-25	7.4-7.8	0-2	0	0.0-2.0	0
	13-21	10-25	7.4-7.8	0-2	0	0.0-2.0	0
	21-40	---	---	---	---	---	---
Bond	0-3	5.0-15	7.9-8.4	0	0	0.0-2.0	0
	3-10	5.0-15	7.9-8.4	0-5	0	0.0-2.0	0
	10-15	5.0-15	7.9-8.4	0-5	0	0.0-2.0	0
	15-20	---	---	---	---	---	---
250:							
Hospah	0-3	15-25	7.9-8.4	0-5	1-5	0.0-4.0	0-5
	3-15	15-35	7.9-8.4	0-5	1-5	0.0-4.0	5-10
	15-20	---	---	---	---	---	---
Skyvillage	0-1	0.0-5.0	7.9-8.4	0-10	0-1	0.0-2.0	0
	1-7	5.0-15	7.9-8.4	0-10	0-1	0.0-2.0	0
	7-20	---	---	---	---	---	---
Rock outcrop	0-60	---	---	---	---	---	---

Table 13.--Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	In	meq/100 g	pH	Pct	Pct	mmhos/cm	
290:							
Rock outcrop	0-60	---	---	---	---	---	---
Westmion	0-2	15-25	7.4-7.8	0-5	0-2	0.0-2.0	0-5
	2-8	15-35	7.4-7.8	0-5	0-2	0.0-2.0	0-5
	8-20	---	---	---	---	---	---
Skyvillage	0-3	5.0-15	7.9-8.4	0-10	0-1	0.0-2.0	0
	3-11	5.0-15	7.9-8.4	0-10	0-1	0.0-2.0	0
	11-20	---	---	---	---	---	---

Table 14.--Soil Features

(See text for definitions of terms used in this table. Absence of an entry indicates that the feature is not a concern or that data were not estimated.)

Map symbol and soil name	Restrictive layer		Potential for frost action	Risk of corrosion	
	Kind	Depth to top		Uncoated steel	Concrete
		In			
2:					
Battlerock	---	---	Low	High	Low
Notal	---	---	Low	High	Low
3:					
Beebe	---	---	Low	High	Low
4:					
Yelives	---	---	Low	High	Low
Beebe	---	---	Low	High	Low
5:					
Farb	Bedrock (lithic)	5-20	Low	High	Low
Rock outcrop	Bedrock (lithic)	0-0	---	---	---
6:					
Chacoan	Bedrock (lithic)	20-40	Low	High	Low
Shiprock	---	---	Low	High	Low
7:					
Chacoan	Bedrock (lithic)	20-40	Low	High	Low
Kimnoli	Bedrock (lithic)	10-20	Low	High	Low
8:					
Notal	---	---	Low	High	Low
9:					
Doak	---	---	Low	High	Low
10:					
Yelives	---	---	Low	High	Low
12:					
Riverwash	---	---	Low	High	Low
13:					
Escawetter	---	---	Low	High	Low
16:					
Rock outcrop	Bedrock (lithic)	0-0	---	---	---
Persayo	Bedrock (paralithic)	5-20	Low	High	Low
17:					
Razito	---	---	Low	High	Low

Table 14.--Soil Features--Continued

Map symbol and soil name	Restrictive layer		Potential for frost action	Risk of corrosion	
	Kind	Depth to top		Uncoated steel	Concrete
		In			
110:					
Benally	Bedrock (paralithic)	40-70	Low	High	Low
Fruitland	---	---	Low	High	Low
115:					
Razito	---	---	Low	High	Low
Shiprock	---	---	Low	High	Low
116:					
Fajada	Bedrock (paralithic)	20-40	Low	High	Low
Huerfano	Bedrock (paralithic)	4-20	Low	High	Low
Benally	Bedrock (paralithic)	40-70	Low	High	Low
121:					
Badland	Bedrock (paralithic)	0-2	Low	High	Moderate
220:					
Hagerwest	Bedrock (lithic)	20-40	Low	High	Low
Bond	Bedrock (lithic)	10-20	Low	High	Low
250:					
Hospah	Bedrock (paralithic)	5-20	Low	High	Low
Skyvillage	Bedrock (lithic)	6-20	Low	High	Low
Rock outcrop	Bedrock (lithic)	0-0	---	---	---
290:					
Rock outcrop	Bedrock (lithic)	0-0	---	---	---
Westmion	Bedrock (paralithic)	6-20	Low	High	Low
Skyvillage	Bedrock (lithic)	10-20	Low	High	Low

Table 15.--Water Features

(Depths of layers are in feet. See text for definitions of terms used in this table. Absence of an entry indicates that the feature is not a concern or that data were not estimated.)

Map symbol and soil name	Hydrologic group	Month	Water table upper limit	Flooding	
				Duration	Frequency
2:					
Battlerock	C				
		April	---	Extremely brief	Rare
		May	---	Extremely brief	Rare
		June	---	Extremely brief	Rare
		July	---	Extremely brief	Rare
		August	---	Extremely brief	Rare
		September	---	Extremely brief	Rare
Notal	D				
		April	---	Extremely brief	Rare
		May	---	Extremely brief	Rare
		June	---	Extremely brief	Rare
		July	---	Extremely brief	Rare
		August	---	Extremely brief	Rare
		September	---	Extremely brief	Rare
3:					
Beebe	B				
		April	---	Extremely brief	Occasional
		May	---	Extremely brief	Occasional
		June	---	Extremely brief	Frequent
		July	---	Extremely brief	Frequent
		August	---	Extremely brief	Occasional
		September	---	Extremely brief	Occasional

Table 15.--Water Features--Continued

Map symbol and soil name	Hydrologic group	Month	Water table upper limit	Flooding	
				Duration	Frequency
4:					
Yelives	B				
		April	---	Extremely brief	Rare
		May	---	Extremely brief	Rare
		June	---	Extremely brief	Frequent
		July	---	Extremely brief	Frequent
		August	---	Extremely brief	Rare
		September	---	Extremely brief	Rare
Beebe	A				
		April	---	Extremely brief	Rare
		May	---	Extremely brief	Rare
		June	---	Extremely brief	Frequent
		July	---	Extremely brief	Frequent
		August	---	Extremely brief	Rare
		September	---	Extremely brief	Rare
5:					
Farb	D				
		All months	---	---	---
6:					
Chacoan	B				
		All months	---	---	---
Shiprock	A				
		All months	---	---	---
7:					
Chacoan	B				
		All months	---	---	---
Kimnoli	D				
		All months	---	---	---

Table 15.--Water Features--Continued

Map symbol and soil name	Hydrologic group	Month	Water table upper limit	Flooding	
				Duration	Frequency
8:					
Notal	D				
		April	---	Extremely brief	Rare
		May	---	Extremely brief	Rare
		June	---	Extremely brief	Rare
		July	---	Extremely brief	Rare
		August	---	Extremely brief	Rare
		September	---	Extremely brief	Rare
9:					
Doak	C				
		All months	---	---	---
10:					
Yelives	B				
		April	---	Extremely brief	Occasional
		May	---	Extremely brief	Occasional
		June	---	Extremely brief	Frequent
		July	---	Extremely brief	Frequent
		August	---	Extremely brief	Occasional
		September	---	Extremely brief	Occasional
12:					
Riverwash	D				
		March	3.5-5.0	Extremely brief	Occasional
		April	3.5-5.0	Extremely brief	Occasional
		May	3.5-5.0	Extremely brief	Occasional
		June	3.5-5.0	Very brief	Frequent
		July	3.5-5.0	Very brief	Frequent
		August	3.5-5.0	Extremely brief	Occasional
		September	3.5-5.0	Extremely brief	Occasional
		October	3.5-5.0	Extremely brief	Occasional

Table 15.--Water Features--Continued

Map symbol and soil name	Hydrologic group	Month	Water table upper limit	Flooding	
				Duration	Frequency
13:					
Escawetter	B				
		March	3.5-5.0	Extremely brief	Occasional
		April	3.5-5.0	Extremely brief	Occasional
		May	2.5-5.0	Extremely brief	Occasional
		June	2.5-5.0	Very brief	Frequent
		July	2.5-5.0	Very brief	Frequent
		August	2.5-5.0	Extremely brief	Occasional
		September	2.5-5.0	Extremely brief	Occasional
		October	2.5-5.0	Extremely brief	Occasional
16:					
Rock outcrop	---				
		All months	---	---	---
Persayo	D				
		All months	---	---	---
17:					
Razito	A				
		All months	---	---	---
110:					
Benally	C				
		All months	---	---	---
Fruitland	B				
		All months	---	---	---
115:					
Razito	A				
		All months	---	---	---
Shiprock	A				
		All months	---	---	---
116:					
Fajada	C				
		All months	---	---	---
Huerfano	D				
		All months	---	---	---
Benally	C				
		All months	---	---	---
121:					
Badland	D				
		All months	---	---	---

Table 15.--Water Features--Continued

Map symbol and soil name	Hydrologic group	Month	Water table upper limit	Flooding	
				Duration	Frequency
220:					
Hagerwest	C	All months	---	---	---
Bond	D				
250:					
Hospah	D	All months	---	---	---
Skyvillage	D	All months	---	---	---
290:					
Rock outcrop	---	All months	---	---	---
Westmion	D	All months	---	---	---
Skyvillage	D	All months	---	---	---

Table 16.--Classification of the Soils

Soil name	Family or higher taxonomic class
Battlerock	Fine-loamy, mixed, superactive, calcareous, mesic Typic Torrifluvents
Beebe	Sandy, mixed, mesic Typic Torrifluvents
Benally	Fine-loamy, mixed, superactive, mesic Typic Natrargids
Bond	Loamy, mixed, superactive, mesic Lithic Ustic Haplargids
Chacoan	Coarse-loamy, mixed, superactive, mesic Typic Haplargids
Doak	Fine-loamy, mixed, active, mesic Typic Haplargids
Escawetter	Sandy, mixed, mesic Oxyaquic Torrifluvents
Fajada	Fine-loamy, mixed, superactive, mesic Typic Natrargids
Farb	Loamy, mixed, superactive, calcareous, mesic Lithic Torriorthents
Fruitland	Coarse-loamy, mixed, superactive, calcareous, mesic Typic Torriorthents
Hagerwest	Fine-loamy, mixed, superactive, mesic Ustic Haplargids
Hospah	Clayey, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents
Huerfano	Loamy, mixed, superactive, mesic, shallow Typic Natrargids
Kimnoli	Loamy, mixed, active, mesic Lithic Haplargids
Notal	Fine, mixed, active, calcareous, mesic Typic Torriorthents
Persayo	Loamy, mixed, active, calcareous, mesic, shallow Typic Torriorthents
Razito	Mixed, mesic Typic Torripsamments
Shiprock	Coarse-loamy, mixed, superactive, mesic Typic Haplargids
Skyvillage	Loamy, mixed, superactive, calcareous, mesic Lithic Ustic Torriorthents
Westmion	Clayey, mixed, superactive, calcareous, mesic, shallow Ustic Torriorthents
Yelives	Coarse-loamy, mixed, superactive, calcareous, mesic Typic Torrifluvents